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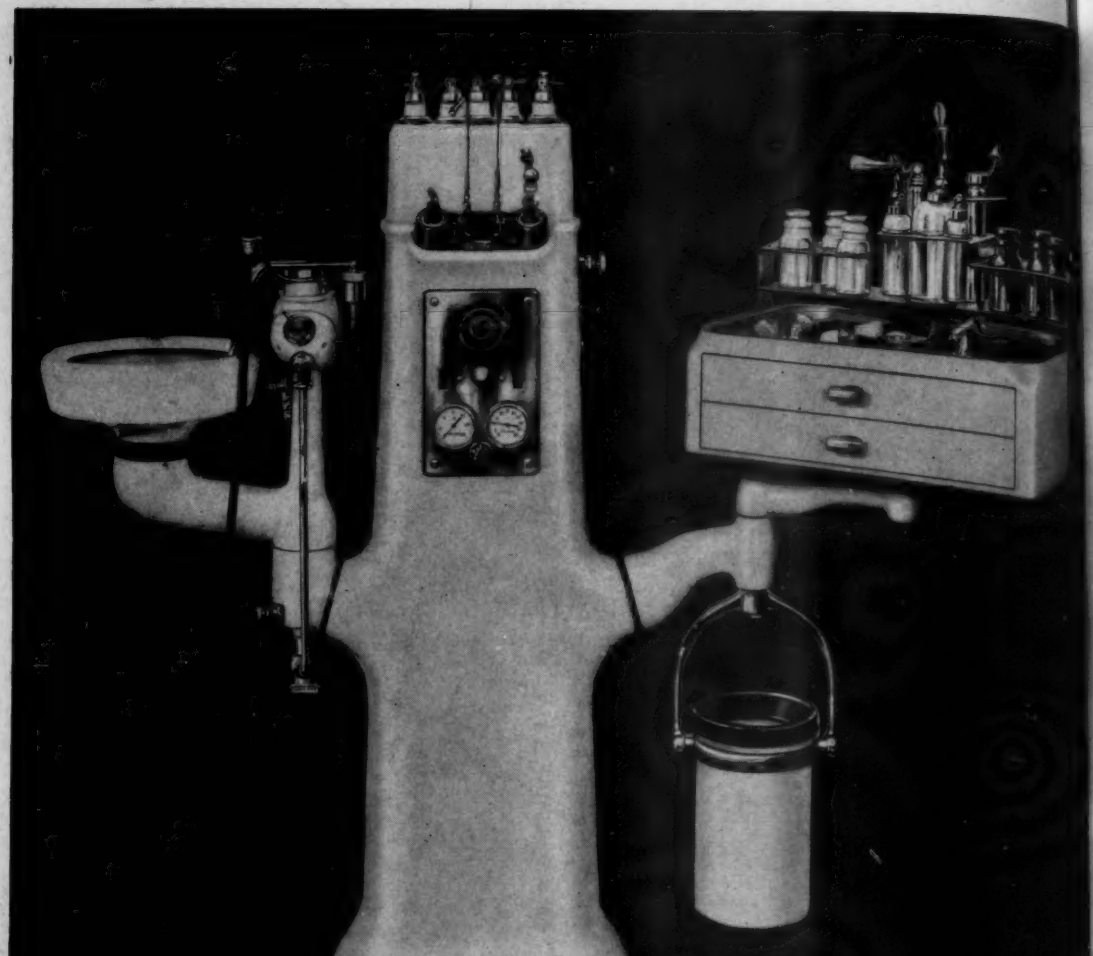

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 24 AUGUST, 1941 NUMBER 8

THE MECHANICAL FACTORS IN THE ETIOLOGY OF ACUTE GLAUCOMA*

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Any clinician who sees a sufficient number of cases of all types of so-called primary glaucoma must be impressed by the fact that classification according to the generally accepted system is often difficult. Many glaucoma patients with histories of intermittent ocular pain, headache, and halos, and having shallow anterior chambers, suggesting so-called congestive glaucoma, are never found to have any evidences of vascular congestion. Late cases of simple glaucoma may come under observation with all the signs of acute vascular congestion. And cases of acute glaucoma following pupillary dilatation usually show no early evidences of congestion and so cannot be properly fitted into the present classification. In order to clear up this confusion, it is necessary to reëxamine our present system of classification and produce evidence to justify it or to discard it as inconsistent with our present stage of ophthalmologic knowledge.

CLASSIFICATION OF GLAUCOMA

We have all been taught that so-called primary glaucoma is one disease entity composed of several related subtypes. Elliot[1] even went so far as to consider even the subdivisions superfluous. He said that "there is no such thing as acute, subacute, and chronic glaucoma. Any glaucomatous eye may be in an acute, a subacute, or chronic stage and may readily pass from one to another of these stages, and back again into that form from which it sprang, but to speak of acute, subacute, and chronic glaucoma, as if we were dealing with so many clinical entities, is wrong, and misleading." Parsons, May, S. Gifford, E. Fuchs, Gradle (in Berens's "The eye and its diseases"), and Duke-Elder all agree to the classification of so-called primary glaucoma as essentially a single disease entity. Duke-Elder[2] states that "although from the etiological point of view it is unjustifiable, it is convenient from the clinical point of view to divide cases of glaucoma into two main groups, each of which presents a completely different clinical picture so that they appear to be separate and unrelated diseases—simple and congestive. . . . The differentiation rests upon the adaptability of the circulation to accommodate itself to the tension. . . ."

Nearly all ophthalmologists today consider primary glaucoma to be subdivided into three groups; namely, acute congestive, chronic congestive, and chronic noncongestive or simple glaucoma. The followers of the Elschnig school have preferred the terms compensated and incompensated to congestive and noncongestive, respectively, but have not, in my opinion, cleared up any of the basic confusion.

*From the Illinois Eye and Ear Infirmary. Under a grant from the Kellogg Foundation of Battle Creek, Michigan. Read before the Chicago Ophthalmological Society, March 17, 1941.

Raeder,[3] in 1923, introduced a more reasonable subdivision of so-called primary glaucoma into shallow-chamber and normal or deep-chamber types. This classification is advocated and supported by Barkan,[4] who divides chronic glaucoma into the same two types. I prefer reference to the angle depth rather than the chamber depth, since Gradle and I[5] have pointed out that, although usually the two are proportionally shallow or deep, there are cases in which the chamber appears to be of normal depth but the angle is shallow.

Classification on basis of gonioscopy

In this paper I propose to give evidence, dealing particularly with acute glaucoma, to show that we are dealing with two distinct disease groups when we speak of so-called primary glaucoma and that our emphasis on the presence or absence of congestion is the chief cause of our confusion, not only clinically, but in clinical research. An example of the confusion due to the present classification is the inclusion in a paper on goniometry by Gradle and myself,[5] of a number of cases of shallow-angle glaucoma in a group of so-called chronic noncongestive-glaucoma cases simply because they were never congested.

The first evidence that we are dealing with two distinct disease entities is suggested by gonioscopic studies. The basic clinical evidence that closure of the chamber angle in previously nonglaucomatous eyes may lead to glaucoma has been presented by me[6] and corroborated by Kronfeld and Grossmann[7] in studies of glaucoma following cataract surgery. With this as a background, studies of the angle in eyes with so-called primary glaucoma can be properly interpreted.

Barkan, from gonioscopic studies, held that both deep- and shallow-chamber types of glaucoma are mechanical, the deep type due to "trabecular sclerosis with or without deposits of pigment" and the shallow-chamber type due to narrowing of the entrance to the angle. The obstructive etiology of the latter type is supported in this paper but as for the former, there is no gonioscopic support.

In a previous paper[6b] I presented gonioscopic findings in a series of 68 eyes with acute glaucoma, in 33 with so-called chronic congestive glaucoma, and in 344 with so-called chronic noncongestive glaucoma.

Of the group with acute glaucoma, all had shallow chambers. In 13 eyes the tension was normalized within one to three days after the onset of the attack. In 9 of the 13 the angle was deep enough to be seen gonioscopically. Six were entirely open and three partly open. The open angles were all in eyes in which the attack had been relieved within 24 hours of its onset. In the three with partly open angles, the attack had lasted 48 to 72 hours. One of the latter had an open area involving about 25 degrees of the angle circumference. In this case the tension was reduced to normal with miotics but subsequently rose again.

Of the 33 eyes with so-called chronic congestive glaucoma, the angle was too shallow for observation in 13; shallow, but open in 19; and closed in 1.

Of the 344 eyes with chronic noncongestive glaucoma, many of which had elevated tensions at the time of examination, the angles were open in 97 percent. The remaining 3 percent were all in late cases or in eyes with absolute glaucoma. The angles in nearly all of these cases could not be distinguished from normal as far as depth was concerned.

The fact that the chamber depth in patients with simple glaucoma does not vary from the normal was first pointed out by Rosengren,[8] who used a highly accurate optical method of measurement. Gradle and I[5] made similar observations.

The evidence from these cases suggests their separation into two groups, according to the depth of the chamber angles. The first group comprises the acute glaucomas and the so-called chronic congestive glaucomas, both with shallow

angles. The second group is the chronic simple group or the so-called noncongestive group, usually with normal chamber-angle depth.

From the acute-glaucoma group of patients, of whom a number were examined gonioscopically before onset of the acute glaucoma in the second eye, and from the group of cases normalized shortly after the onset, it appears that the angle is normal but shallow before the time of onset of the attack, but is closed during the attack. If miotics are effective, at least a portion of the angle is opened and the tension is reduced to normal. If the attack persists for over two to three days, the adhesions usually have become firm, and surgery must be resorted to. In the so-called chronic-congestive-glaucoma group, the same process probably takes place but to a lesser degree.

The evidence suggests that in cases of shallow-angle glaucoma, closure of the chamber angle by the root of the iris is the chief etiologic factor.

The second group of evidence for the need for definite separation of so-called primary glaucoma into two distinct etiologic groups is that derived from a study of 49 cases (74 eyes) with acute glaucoma (including four associated with intumescent lenses). The history in each case was reviewed to determine as far as possible any factors of etiologic importance. No cases were included in which the findings suggested any possibility of any other type of glaucoma than those under consideration.

In 41 eyes the onset in this group of cases was associated with the following several conditions:

1. Following a period in a darkened moving picture theater (11 eyes in 10 patients).
2. Following dilatation of the pupil by mydriatic drugs used for refraction or in therapy (13 eyes in 12 patients).
3. Following weeping associated with emotional experiences (6 eyes in 4 patients).
4. During acute rhinitis, influenza, or coryza (4 eyes in 4 patients).
5. Following surgery (2 eyes in 2 patients): (a) one following glaucoma operation on the fellow eye; (b) one following extraction of 14 teeth at one sitting.
6. During excitement (6 eyes in 6 patients—in one while playing cards, and in one following an argument).
7. Following or during reading, crocheting (7 eyes in 7 patients).
8. Associated with intumescent cataract (4 eyes in 4 cases).

In the remaining 33 of the 74 eyes under consideration, no definite associated etiologic factor could be elicited (table 1).

We may group the first two of the foregoing list into a *mydriasis group* in which the angle is believed to be blocked by thickened iris tissue. To determine whether or not pupillary dilatation may provoke acute glaucoma and whether the chamber angle is blocked under such conditions, one or more drops of either 2-percent euphthalmine-hydrochloride, 1-percent paredrine-hydrobromide, or 2-percent homatropine-hydrobromide solution or combinations of these drugs were instilled into 13 nonglaucomatous eyes of patients with unilateral acute glaucoma and into 7 acute glaucomatous eyes which had been normalized with miotics. In 6 of the 20 eyes thus provoked, the tension rose to a high level and afterward was quickly reduced to normal by the use of a miotic drug. In case 18 the tension dropped from 60 mm. Hg (Schiötz) to 24 mm. in 20 minutes. Two of the six eyes were in previously nonglaucomatous mates of acute glaucomatous eyes. In all

TABLE 1

ETIOLOGICAL FACTORS AND VASCULAR CONGESTION IN CASES OF ACUTE GLAUCOMA

Number and Eye	Age	Etiologic Factors	Congestion at Onset	Refractive Error
1R	47	movies, reading	no	+1.50×90
L		dilatation	no	+3.00+1.00×90
2R	38	—	—	+8.50+0.75×180
L		movies, reading	no	+8.00+0.50×180
3R	47	?	?	
L		?	no	+2.50+3.00×90
4R	65	movies, reading?	no	
L		?	?	+1.00
5R	64	weeping	yes	
L		weeping	yes	+3.50
6R	51	playing cards	no	+2.25
L		—	—	+2.25+0.50×90
7R	44	dilatation	no	
L		?	no	
8R	63	dilatation	no	
L		?	yes	
9R	56	movies	no	+1.75
L		—	—	+1.75
10R	69	acute rhinitis	yes	+1.50
L		—	—	+1.50+1.50×60
11R	40	—	—	+1.25+0.50×110
L		dilatation	no	+1.00+0.50×90
12R	70	—	—	+4.00+1.00×180
L		dilatation	no	+3.00
13R	54	?	no	+1.50×20
L		influenza	no	
14R	57	excitement, dilatation	no	
L		during postoperative period of right-eye surgery	?	
15R	54	weeping	yes	+4.25−0.50×165
L		—	—	+5.25+1.25×150
16R	69	?	no	−2.50
L		?	no	−2.00−2.50×45
17R	50	?	no	+0.50
L		—	—	+0.50
18R	45	movies, reading	no	
L		movies, reading	no	
19R	39	—	—	+4.50+1.00×105
L		dilatation	no	+4.50+1.00×60
20R	59	?	?	−0.50−0.50×90
L		?	no	
21R	58	dilatation	slight	−1.50
L		?	no	−1.50
22R	39	dilatation	no	+2.00+0.25×90
L		movies, excitement, dilatation	no	+1.25×120
23R	44	movie	?	+2.00
L		—	—	+3.00
24R	51	movies, reading	?	+3.00
L		—	—	+3.25+0.25×25
25R	65	?	yes	
L		?	yes	
26R	73	weeping, emotional upset	yes	
L		weeping, emotional upset	yes	
27R	21	movies, reading, dilatation	no	+4.00+1.00×60
L		—	—	+4.50+0.50×120
28R	68	?	?	+1.25+0.50×90
L		?	no	
29R	42	movies	no	+1.25+3.25×95
L		—	—	+0.75+0.25×105
30R	68	—	—	+2.50
L		?	?	+2.50
31R	41	—(provoked)	no	+0.75
L		?	no	+0.75+0.50×15

TABLE 1—*Continued*

Number and Eye	Age	Etiologic Factors	Congestion at Onset	Refractive Error
32R	67	?	slight	
L		—	—	
33R	71	?	no	−1.25−0.50×45
L		?	no	
34R	58	reading	yes	+0.25+0.50×30
L		?	no	+0.37+0.50×165
35R	64	?	no	1936+1.75
L		during coryza	no	1936+1.75 1940−1.50+0.50×180
36R	50	dilatation	no	
L		?	no	+2.50+0.75×90
37R	69	?	?	+3.00+0.50×90
L		?	yes	+2.50+2.50×90
38R	48	crocheting	?	+1.50
L		after extraction of teeth	yes	
39R	66	?	no	'38+2.00+1.00×90; '39−0.75
L		?	?	+0.25+0.50×120
40R	61	?	no	+2.25
L		—	—	+2.25
41R	60	?	no	
L		dilatation	no	
42R	58	?	?	+6.00
L		argument	no	+6.00+1.75×145
43R	73	?	?	
L		?	yes	−1.00
44R	48	emotional disturbance, cold	?	+3.50
L		weeping	no	
45R	56	?	no	+4.00+0.75×180
L		—	—	+2.75+0.75×180

but one of the cases examined the chamber-angle depth was measured by the gonioscopic method described by Gradle and myself,[5] before, during, and after dilatation. In each of the patients with positive findings, the angle was open before dilatation but closed by the forward position of the iris at the end of dilatation. In the negative cases the angle remained patent, though narrowed.

The first provocative dilatations were done with the euphthalmine solution without positive results. Because I believed that if the pupil could be dilated sufficiently to force the iris to block the angle, positive results would be obtained, the tests were repeated with paredrine or homatropine solution or both, giving positive results in three cases. In one case, in which paredrine was similarly ineffective, homatropine solution gave positive results. In each of these cases the drug that produced the greater dilatation yielded the positive results (table 2).

Photographic measurements of the anterior-chamber depth before and after dilatation were made, using the slitlamp beam (as described by Friedenwald[9]) for illumination (fig. 1). The camera was placed at an angle of 45 degrees from the axis of the beam and eye. The photographs were projected and enlarged 27.2 times as compared to a control, and the measurement thus obtained divided by the magnification factor and multiplied by $\sqrt{2}$ to correct for the angle of view (without considering correction for the corneal curvature). No difference between the depth before dilatation and that at the height of the tension was observed, indicating the important fact that shallow-angle glaucoma is not related etiologically to any acute change in the axial depth of the anterior chamber and

implying that changes in the volume of the vitreous chamber are not responsible for the glaucoma.

In four of the positive-provocation cases, both anterior chambers were compared in depth photographically. In all four the chamber was deeper in the eye with less marked or no evidence of glaucoma (table 2).

A relationship obviously exists between the anterior chamber and angle depths, the size of the pupil, and the iris thickness when dilated, in the etiology of acute mydriatic glaucoma. The time factor necessary for dilatation and the building up of tension must also be considered, especially in provocative testing. An interesting example of the latter is case 8 in which a provocative test with 6 drops of 2-percent euphthalmine-hydrochloride solution had caused a rise of only 3 mm. Hg in each eye in one hour. The test had been called negative and the patient allowed to go home. An acute glaucomatous attack occurred that evening, about six hours later, requiring surgery subsequently.

An interesting conclusion from the rapid rise of tension with dilatation and its rapid reduction with miotics associated with the visible changes in the angle is that we have here further clinical corroboration of the continuous-aqueous-circulation theory of Leber.

Experience with the provocative tests has shown conclusively that any rise in tension following mydriasis can be immediately and effectively controlled with miotics. For this reason there should be no fear of using mydriatics for any reason, as long as the drug used can be counteracted by miotics shortly afterward.

TABLE 2

PROVOCATIVE PUPILLARY DILATATION TO PRECIPITATE ACUTE GLAUCOMA

Case Number and Eye	Drug HA—homatropine P—paredrine E—euphthalmine	Maximum Pupillary Dilatation (mm.)	Time to Develop Tension (hrs.)	Tension Before Dilat. (Schiötz)	Tension After Dilat.	Ant.-Chamber Depth (mm.)	Ant.-Chamber Depth of Other Eye (mm.)
2R	HA	7	3	17 mm.	17 mm.	1.18	0.78
9L	P, HA	4.5	3¼	19.5	21	0.97	0.97
10L	P, HA	4.0	2½	18	24		
11R	E, P, HA	5.5	4	18	18	1.40	1.30
12R	HA	7.0	4½	23	23	0.88	0.72
15L	E	5.5	1¼	18	18	0.51	
same	P	6.5	3¼	18	*60*	0.51	
16R	P, HA	4.5	2¾	21	21	1.58	
17L	E	5.0	1	19.5	19.5	1.03	
same	HA	5.5	3	21	21	1.03	
18L	E	4.5	½	28	*60*	1.55	1.30
19(OP)L	E	4.5	2	21	20	1.36	1.40
same	HA	6.0	2	24	*60*	1.36	1.40
19R	HA	6.0	2	24	26	1.40	1.36
22L	E	4.5	¾	26	*57*	1.13	1.30
23L	E, P, HA	6.5	4½	23	26	0.92	
29R	E	—	3	15	*43*	1.18	1.40
29L	P, HA	7.0	2¾	15.5	20	1.40	1.18
31(OP)R	E	4.0	2	19.5	24.5	1.55	
same	P, HA	5.0	2¼	23	*57*	1.55	
32L	P, HA	4.5	3½	21	21	1.53	1.47
35R	P	5.0	2½	19.5	24.5		
37L	P	4.5	2	15	15	0.92	
same	HA	6.5	3¾	15	*52*	0.92	
45R	E	7.0	1½	13.5	24.5	1.65	1.50
same	HA	7.0	3	21	24.5	1.65	1 50

Emotional disturbances, often associated with weeping; rhinitis, coryza, and influenza; excitement; and surgery about the head, the next four headings in our list of conditions associated with the onset of acute glaucoma, may be placed together as a *ciliary-body congestion* group. Weeping and coryza are usually obviously associated with externally visible congestion. Flushing of the face and peripheral vascular dilatation are associated with excitement. Surgery about the head is followed by reactive vasodilatation that may involve the orbital structures temporarily. In eyes with shallow angles, it is reasonable and probable that ciliary-body congestion is the precipitating factor in certain cases of acute glaucoma by the pushing forward of the iris root mechanically. In these cases externally visible congestion is usually associated with the glaucoma from the very beginning.

Reading or close work requires accommodation in prepresbyopic individuals or the use of a convex lens in addition to the distance correction in the presbyopic. In seven eyes in the present series of cases of acute glaucoma, *accommodative effort* was associated with the onset of ocular hypertension or at least its symptoms. All but one of these seven were in the prepresbyopic age group. The association of accommodation and the onset of acute glaucoma is rather paradoxical in view of previous teachings that accommodation with its associated miosis is beneficial for glaucoma patients. Grönholm[10] studied the influence of mydriasis and miosis on the tension of the eye and concluded that the filtration angles are opened by the action of accommodation and by contraction of the pupil. He believed that glaucoma patients should be advised to read in a bright light as much as possible, as long as they have any accommodative power and their pupils contract under the influence of light. Thomson,[11] independently came to the same conclusion, from an anatomic point of view. The only positive clinical association of accommodation and ocular hypertension is the provocative reading test described by Gradle[12] in 1931. I attempted to study this question by observing the effect of accommodation on the chamber angle directly, by the following method: A gonioscopic contact lens was placed on one eye of a recumbent, practically emmetropic, prepresbyopic individual. He was asked to observe an object (a printed word) held about 12 inches from the other eye. A +4.00 D. sphere was placed in front of the reading eye and the chamber angle of the eye covered with the contact lens was observed with the binocular microscope. When the reading lens was removed, a slight convergence movement was observed, followed after a short lag period by movement forward of the ciliary zone of the iris. The subject's description of his own sensation of accommodation corresponded to the observed movement. Motion pictures of the action were obtained. The process was observed in 4 prepresbyopic acute-glaucoma patients and in 40 normal individuals from 15 to 83 years of age. The accommodative movement was strongest in young individuals, and decreased in amount as age advanced, becoming hardly perceptible in the late 40's and early 50's. The amount of iris movement can be measured goniometrically.[5]

Forward movement of the iris root on accommodation tends to decrease the chamber-angle depth and in cases in which the latter is already shallow, is of considerable importance in the etiology of acute glaucoma, especially in younger individuals. Reading should be avoided, at least without reading additions in the glasses, in patients with shallow angles.

Intumescent cataract. It is accepted by ophthalmologists that the type of glaucoma associated with intumescent cataract is the result of blockage of the chamber angle. Actually there is no anatomic difference between the angle in this type of glaucoma and that in the ordinary type of acute glaucoma. If the glaucoma associated with intumescence of the lens persists sufficiently long before treatment, miotics are ineffective and surgery is required, just as in acute glaucoma. In one 70-year-old glaucoma-free patient with intumescent cataract, provocation was afforded by the dilating of the pupil with a 1-percent paredrine-hydrobromide solution (one drop) to prove the truth of the theory that closure of the angle in these cases causes glaucoma. Refraction previously had shown the eye to be myopic 14 diopters. The tension in the eye under consideration was 17.5 mm. Hg (Schiötz). Forty minutes after the instillation of the paredrine solution, the pupil had dilated from 4 to 8 mm. and the tension had risen to 48 mm. Hg. The angle was then too shallow for gonioscopy. A drop of 2-percent pilocarpine solution rapidly reduced the tension to normal.

It is important to note in table 1 that one eye in a case of bilateral acute glaucoma may have developed glaucoma during or after reading while the other eye may have started after dilatation with a mydriatic drug during refraction, or that both reading and a period in a darkened motion picture theater had the same effect in producing symptoms in the same eye. These suggest that with the same anatomic background, unrelated precipitating factors will produce the same end result by mechanically blocking the drainage angle.

Vascular congestion in acute glaucoma. All classical descriptions of acute glaucoma include redness and congestion of the involved eye or eyes, without investigation of the exact onset as to whether the eye was painful and the vision blurred before the eye became red or whether the eye was red from the onset. A tabulation of the presence or absence of vascular congestion from the onset of ocular symptoms is shown in table 3.

TABLE 3

CONGESTION AT ONSET OF ACUTE GLAUCOMA

Condition Associated with Onset of Acute Glaucoma	No Congestion at Onset	Congested at Onset	Indefinite or Undetermined
1. Mydriasis group			
a. movies	9	0	2
b. dilatation	12	1 (slight)	0
2. Ciliary-body-congestion group			
a. weeping	1	5	0
b. coryza, and so forth	2	1	1
c. postoperative	0	1	1
d. excitement	4	1	1
3. Reading, close work	4	1	2
4. Intumescent cataract	3	0	1
5. Undetermined			32

In the mydriasis group nearly all of the eyes were free from congestion at the onset (95.4 percent of those in which the presence or absence of congestion was determinable). It is obvious that since the eyes were *not* congested the condition cannot be classified as acute congestive or acute incompensated glaucoma. Similarly, since the condition is acute, it cannot be properly considered as chronic simple or chronic compensated glaucoma. Under the present nomenclature the condition

should more properly be considered acute noncongestive or acute compensated glaucoma, which is not really a part of the present classification.

In the ciliary-body-congestion group 53.3 percent were congested from the onset. In those associated with accommodation and intumescent cataract, nearly all were free from congestion. It appears, then, that in a majority of cases of acute glaucoma the onset is not associated with vascular congestion, but, after a varying period, ranging from several hours to days, the eye becomes red because the vascular system of the eye can no longer tolerate the acute ocular hypertension. Except for those cases associated with ciliary-body congestion from the onset, we may say that nearly all glaucomatous eyes are initially free from congestion, and only later develop congestion. If we then discard congestion as a criterion for the classification we remove the chief barrier to the understanding of glaucoma. If we wish to describe the condition of the vascular reaction of the eye under consideration, we may say that the eye is in the noncongestive phase or in the congestive phase of a particular disease group classified under the heading of glaucoma.

Shallow chambers and shallow angles. Let us now digress to discuss the factors which lead to shallow chambers and shallow angles. Three factors are to be considered: first, the dimensions of the eyes in the patients under consideration; second, the errors of refraction; and third, the continuous growth of the lens throughout life.

1. Dimensions of the eyes. Priestley Smith[13] stated that the eyes of glaucomatous patients are, on the whole, a little smaller than normal. He found the average horizontal diameter of the cornea to be 11.17 mm. in glaucomatous and 11.6 mm. in nonglaucomatous eyes. He did not, however, distinguish between the types of glaucoma.

2. Errors of refraction. Fuchs[14] stated that "a disposition toward inflammatory glaucoma appears to belong principally to hypermetropic eyes, whereas strongly myopic eyes are to be regarded as having almost complete immunity against the disease." In my series of eyes with acute glaucoma, the refraction was known in 62. Only seven were myopic, averaging 1.71 diopters. The maximum myopia was equivalent to a −3.25 diopter sphere. All seven were in the age group from 58 to 73 years, and all had nuclear sclerosis. Two had definite lens opacities. The 55 hyperopic eyes averaged 2.85 diopters, the maximum equivalent to a +8.87 diopter sphere. Two of the hyperopic eyes became myopic following glaucoma surgery. I have previously pointed out the fact that in hyperopic eyes the iris root is inserted farther forward on the anteromedial surface of the ciliary body, which accounts for the shallowness of the angle, and that in the myopic, the iris root is conversely inserted farther back, consequently the chamber and angle are relatively deep.

The actual relationship between anterior-chamber depth and the amount of refractive error in 191 nonglaucomatous emmetropic and hyperopic subjects between the ages of 25 and 45 years, inclusive, was determined and tabulated from the tables of Rosengren[8] (see table 4). In spite of the individual variations in chamber depth there is a fairly constant decrease in chamber depth with increase in hyperopic refractive error. It must be noted that the grouping as to the amounts of refractive error is empirical and does not include high refractive errors. A study of the latter is being made for further evidence to support the contention that the chamber depth varies rather constantly with the axial refraction in in-

dividuals of the same age group.

3. Continuous growth of the lens throughout life. According to Priestley Smith the cornea increases in size little, if at all, after the age of 5 years, and possibly diminishes slightly after the age of 40. The lens, however, continues to grow in size throughout life. This causes definite shallowing of the chamber and angle but is ordinarily of little significance except in those in whom the shallowness reaches a marked degree. It is probable that in hyperopic persons, in whom the chamber is relatively shallower than normal originally, the increased growth of the lens is the main factor in the increasing shallowness of the chamber and angle.

It appears to me that shallowness of the anterior chamber and angle is an anatomical condition and only as such is a predisposing factor to ocular hypertension.

This evidence leads to the conclusion that acute glaucoma is due to mechanical obstruction of already shallow chamber angles in anatomically predisposed eyes. The attacks, contrary to previously held views, start most frequently without congestion, and only after the vascular system of the eye no longer can tolerate the high tension does congestion supervene. If repeated attacks subside while the eye is still in the noncongestive phase, we may have been calling the disease chronic simple glaucoma simply because of the lack of congestion. This error has been pointed out by Barkan.[4] Actually, all prodromal attacks and short recurrent attacks differ from the typical acute glaucoma only in degree.

It would seem, then, that the classification of acute glaucoma as acute congestive or acute incompensated glaucoma is unjustifiable. We should better say that

TABLE 4

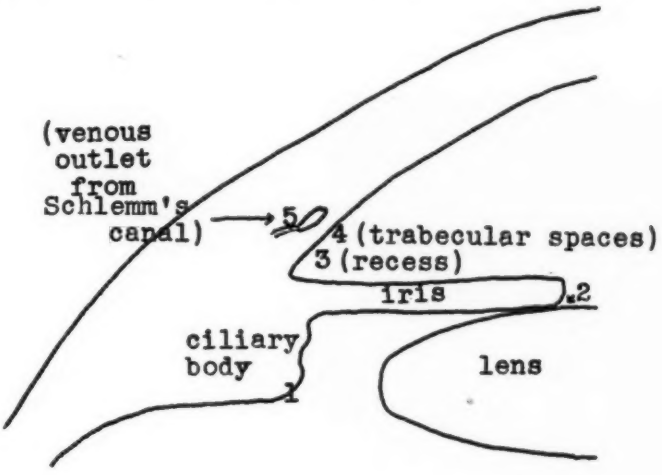
THE RELATIONSHIP BETWEEN CHAMBER DEPTH AND REFRACTIVE ERROR IN INDIVIDUALS BETWEEN THE AGES OF 25 AND 45 YEARS, INCLUSIVE

Age	Hyperopic Refractive Error				
	0 to 0.50 D.	0.75 to 1.00 D.	1.25 to 1.50 D.	1.75 to 2.50 D.	2.75 to 3.50 D.
	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)
25	3.55 (3)	3.59 (8)	3.57 (5)		
26	3.79 (3)	3.39 (5)	3.36 (5)		
27	3.57 (4)				
28	3.38 (3)	3.48 (7)			
29	3.79 (2)	3.54 (3)	3.46 (3)	3.54 (2)	
30	3.80 (2)	3.63 (6)	3.12 (2)		
31	3.27 (6)	3.79 (6)	3.58 (2)		
32	3.43 (6)	3.36 (8)	3.16 (4)		
33	3.89 (2)	3.16 (2)	3.73 (2)		
34	4.15 (2)	3.71 (3)	3.22 (3)		
35	3.44 (7)	3.46 (5)	2.98 (3)	3.23 (1)	
36	3.85 (3)	3.60 (3)	3.38 (4)		
37	3.62 (2)	3.50 (2)	—	2.95 (2)	
38	3.44 (4)	3.61 (2)	3.20 (2)	3.51 (2)	
39	3.24 (4)	3.22 (7)	3.45 (2)		
40	3.42 (3)	3.32 (10)	3.07 (3)		
41	3.33 (7)	3.29 (6)	3.26 (3)		
42	3.49 (8)	3.48 (11)	3.50 (6)	2.83 (3)	
43	3.50 (6)	3.45 (7)	3.38 (10)	3.19 (3)	
44	3.38 (8)	3.44 (15)	3.32 (4)	3.09 (3)	2.91 (1)
45	3.45 (8)	3.37 (9)	3.26 (5)		
Average of above values	3.56	3.46	3.33	3.19	2.91

* Figures in parenthesis indicate number of eyes in each group.

SUGGESTED ETIOLOGIC CLASSIFICATION OF GLAUCOMA

A. Primary or Idiopathic Glaucoma—*Chronic Simple Glaucoma* (except those cases listed below under arteriosclerosis or under marked pigmentary deposits).



B. Secondary Glaucoma
1. Irritation of ciliary processes—*lens dislocation.*
2. Lack of communication between anterior and posterior chambers—
seclusio pupillae.
total posterior synechia.
3. Mechanical obstruction of the chamber angle—

Shallow Angle
- *acute obstructive glaucoma,* including dilatation glaucoma.
- *recurrent obstructive glaucoma* (so-called chronic congestive glaucoma).
- *glaucoma associated with intumescent lens.*
- *glaucoma following cataract operations.*

4. Failure of osmotic forces
(a) *Arteriosclerosis* of afferent vessels to Schlemm's canal (Friedenwald)—at least part of the group of chronic simple glaucoma.
(b) Obstruction of trabecular spaces—
glaucoma capsulare.
pigmentary obstruction—when marked.
cellular debris in *iridocyclitis.*
tumor growth in angle.
(c) Increased protein in aqueous—severe uveitis.
(d) Toxic—in severe retinal-vitreous hemorrhage—*central-retinal-vein occlusion* and probably in *diabetic rubeosis.*
5. Obstruction of venous drainage—experimental and clinical glaucoma following *vortex-vein occlusion.*
6. General vascular hyperemia—reactive hyperemia following *concussion* and histaminelike reaction of *epidemic dropsy.*
7. Congenital anomalies—*hydrophthalmos.*
juvenile glaucoma.

we are dealing with an acute glaucoma or possibly an acute obstructive glaucoma in the congestive phase or the noncongestive phase.

In contrast to acute glaucoma, cases of chronic simple glaucoma, even in the presence of elevated intraocular tensions, exhibit no visible narrowing of the chamber angle. This fact alone indicates that we are dealing with two separate diseases. As in the case of acute glaucoma, a congestive phase may occur late in the

course of simple glaucoma, especially after the eye has become totally blind. We should not call this phase acute glaucoma even though it may be sudden and severe in its onset since it is only the result of

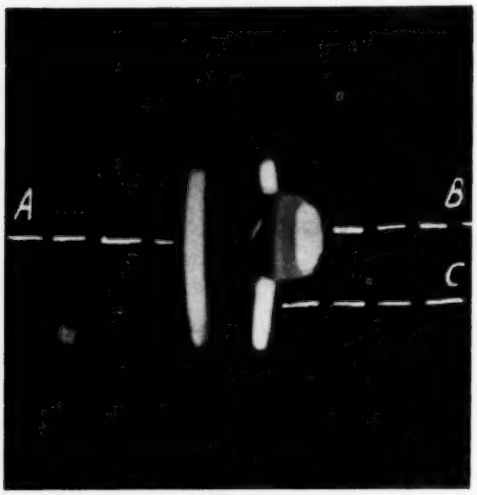


Fig. 1 (Sugar). Slitlamp section of anterior chamber for photographic measurement of chamber depth. A, cornea; B, lens; C, iris.

the long-standing hypertension's effect on the vascular system of the eye.

There may be those who believe that the two diseases must be closely related since medically they are both treated with the same drugs. If so, they should be reminded that the miotic drugs have another effect apart from miosis; namely, vasodilatation. In acute glaucoma, the miotic effect is desired, while in simple glaucoma the vasodilatation may act by increasing the area of vessel-wall surface in the iris available for osmotic absorption of the aqueous.

In order to further our etiologic knowledge of each of the many different conditions having the common manifestation of increased intraocular pressure, we must have a bird's-eye view of the separate components of the group and their relationship to one another. On page 861 is a suggested classification prepared with this view in mind. The only type of glaucoma that we will consider as primary or idiopathic is the one now known as chronic simple, noncongestive, or compensated glaucoma. At least a portion of the cases now considered in this category are probably on an arteriosclerotic basis, as has been shown by Friedenwald.[15] A small number may be due to marked pigment deposition in the trabecular spaces (Barkan). These exceptions, and all other types of glaucoma will be considered as secondary (of known or at least probable etiology) and listed according to that portion of the pathway of aqueous circulation which is involved.

Case histories

Case 1. A man, aged 47 years, early in 1939 had an irritable, slightly painful right eye. Halos were noted. Moving pictures caused headache and blurring of vision, but there was no redness. Reading caused a tired sensation in the eyes in about 10 to 15 minutes. On August 18, 1940, the patient awoke with slight headache, pain in the right eye, and slight congestion of the pericorneal vessels. The symptoms became worse as the day progressed. By evening the eye had become quite red, and the pain severe. On the following day the patient was seen at the Illinois Eye and Ear Infirmary. The tension was 69 mm. Hg (Schiötz) right, and 26 mm. left. Because of a diagnosis of secondary glaucoma due to uveitis, atropine was used until the fourth day, when miotics were administered without avail. On the fourth hospital day the pupil of the left eye had been dilated with euphthalmine for examination. Two hours later the patient began to have pain in the left eye. The eye did not become red until the following day when the tension was 60 mm. Hg. Miotics in this eye were ineffective. Iridectomy was performed on the left eye on August 26,

1940, and on the right eye on September 1, 1940.

Case 2. A woman, aged 38 years, had for two years before coming to the Infirmary experienced blurring of vision with the left eye during and after seeing movies. Occasionally the blurring was accompanied by ocular pain, nausea, and vomiting. There was never any redness of the eye. During the same period reading had caused enough discomfort to cause her to avoid it. One week after being refracted under homatropine cycloplegia at the Infirmary, she awoke in the night with headache. The eye was not red. The following morning the patient was nauseated and vomited, but the eye was still pale. She went to the Infirmary the same day, where the tension in the left eye was found to be 60 mm. Hg (Schiötz). Miotics were promptly effective in reducing the tension to normal. Provocative dilatation of the right eye with 2-percent homatropine-hydrobromide solution was ineffective in raising the tension in three hours.

Case 3. A man, aged 47 years, in March, 1934, noticed that the vision of the right eye was blurred; his head ached. Redness of the eye was not definitely ascertained. The symptoms cleared with medical treatment. In October, 1934, the right eye became red and painful. It again was effectively treated with "drops." On December 8, 1934, he came to the Infirmary. The tension was 65 mm. Hg (Schiötz). Miotics were ineffective in reducing the tension and surgery was resorted to.

Left eye. On one occasion during treatment of the right eye at the Infirmary, the tension in the left eye was 37 mm. Hg. The eye was pale. A cyclodialysis was performed. On December 7, 1936, the eye became red and the vision blurred. On examination at the Infirmary four days later, the tension in the left eye was 56 mm. Miotics failed to control the tension so recourse was had to further glaucoma surgery.

Case 4. A woman, aged 65 years, about eight years before being seen at the Infirmary on June 29, 1939, would awaken at night with severe headache and blurred vision. The eyes were never red. She always had discomfort after attendance at the movies and felt that reading caused "eyestrain." In 1934, at 2:30 p.m. on Christmas Day she awoke with severe pain and blurring of vision in both eyes. The eyes remained pale until after bilateral iridectomies were performed.

Case 5. A woman, aged 64 years, in December, 1933, experienced blurring of vision of the right eye and ocular pain, which was promptly relieved by applications of heat. Two weeks later, two days following an accident in which her son was injured and associated on her part with much weeping, the right eye became red and painful. Nausea and vomiting were present. In spite of treatment by the family physician, the eye remained red and painful. When seen at the Infirmary four months after the onset of the attack, the eye was stony hard. At this time the left eye was also hard, although the patient had referred all her symptoms to the other eye. The left eye was red. Eserine was effective in promptly reducing the tension to normal, after which an iridectomy was performed.

Case 6. A man, aged 51 years, in January, 1939, while playing cards, became aware of a painful right eye and blurred vision. The eye was not red until the following morning. No treatment was sought for two weeks. Four weeks after the onset of the attack, examination at the Infirmary revealed a stony-hard eye which responded only to surgical treatment. Provocative dilatation of the other eye with paredrine for three hours was ineffective in raising the tension. Both

chambers were seen to be shallow.

Case 7. A woman, aged 44 years, had had both pupils dilated for fundus study elsewhere at 4:30 p.m. in August, 1940. That evening the patient had no symptoms. The next morning the vision was blurred, the eyes were red, and headache was present. Treatment was instituted by the patient's physician on the following day and continued for two weeks. She was then referred to the Infirmary, where the tension in the right eye was found to be 67 mm. Hg (Schiötz). Miotics were ineffective. An iridectomy was performed a week later. Tension in the left eye was 57 mm. on November 7, 1940, promptly relieved by miotics. The eye was not red. A trephining was done four days later.

Case 8. A man, aged 63 years, on May 1, 1940, came to the Infirmary with a history of an attack of blurring of vision, slight ocular pain, and redness of the left eye six years previously. That episode had lasted for three weeks and was relieved by "drops." On examination, vision in the right eye was 20/15 corrected, and in the left eye, 20/50. The tensions were 19.5 mm. right, and 21 mm. Hg (Schiötz) left. On May 13, 1940, the patient was given a euphthalmine provocative test. The tension was 15 mm. in each eye. After one hour it was 18 mm. in each eye. The test was called negative by the resident and the patient allowed to leave. That evening the eyes were uncomfortable. The next morning the right eye was red and painful, and the vision reduced. Nausea and vomiting were present. The patient was seen that day at the Infirmary, where the right eyeball was found to be hard. Bullous edema of the corneal epithelium was present. Miotics and sucrose intravenously were ultimately ineffective, and an iridencleisis operation was performed on the right eye six days later.

The pupil of the left eye was irregular, and the chamber shallow. Apparently there had been an attack of acute glaucoma in the left eye, as indicated by the history.

Case 9. A woman, aged 56 years, began in November, 1938, to notice halos and occasional headache when coming home from movies. The eyes were never red, and the symptoms were always relieved by cold applications. In August, 1939, while on a trip, the right eye became painful, and later red. An oculist whom she consulted referred to the condition in a letter as acute glaucoma. The use of miotics was successful in relieving the attack within four hours after beginning treatment. On returning from the trip, the patient was seen at the Infirmary. Tension in the right eye was 80 mm. Hg (Schiötz), but the eye was not red. Miotics promptly reduced the tension to normal. A similar blurring and pain involved the right eye on April 15, 1940. The increased tension was promptly reduced to normal with miotics. The eye was not red.

Provocative dilatation of the left pupil with paredrine and homatropine solutions was ineffective in causing an acute glaucomatous attack. The pupil could not be dilated beyond 4.5 mm. in 3¼ hours.

Case 10. A woman, aged 69 years, was awakened from sleep at 3:00 a.m., in August, 1939, during an acute rhinitis episode, because of a very painful right eye. The eye was red. After one and a half weeks, the patient was seen at the Infirmary. Miotics were ineffective and iridectomy was performed on August 26, 1939. The left eye never showed evidence of glaucoma, although the chamber was very shallow. Provocative dilatation of the pupil of the left eye with paredrine and homatropine solutions was ineffective in precipitating an attack of glaucoma. The pupil could not be dilated beyond 4 mm. in two and a half hours.

Case 11. A woman, aged 40 years, had

had no ocular symptoms until a homatropine refraction was done on June 20, 1940, following which the tension in the left eye was 50 mm. Hg (Schiötz). Both angles were open and shallow on subsequent examination. Dilatation of the pupil of the right eye as a provocative test for four hours with 2-percent homatropine hydrobromide was ineffective. The pupil could not be dilated beyond 5.5 mm.

Case 12. A woman, aged 70 years, had had no ocular symptoms until a euphthalmine refraction was done. Both chambers were shallow. The tensions after refraction were 21 mm. Hg right, and 43 mm. left. Later, after a period of normal tention, provocative dilatation of the pupils with 2-percent euphthalmine was successful in raising the tension of the left eye to 60 mm. Another provocative test of the right eye on September 9, 1940, with 2-percent homatropine hydrobromide solution for four and one-half hours was unsuccessful. The maximum pupillary dilatation was 7.0 mm.

Case 13. A woman, aged 54 years, in 1932 suddenly noticed blurring of the vision of both eyes one evening. The corneae appeared frosty, but both eyes remained pale. On the next day both eyes became injected, but the patient had no ocular pain. For three weeks she was treated as having acute iritis and was then referred to the Infirmary by a second physician who believed the patient had acute glaucoma. The right eye was operated on. The left eye appeared normal and remained so until February 17, 1939, when, during an attack of influenza, the patient had sudden pain and blurring of vision in this eye, but without redness. On the following day she was seen by a physician, who used atropine at first, and later eserine. The tension was not reduced and required surgery. The left eye was never red during the preoperative period.

Case 14. A woman, aged 57 years, on several occasions during the summer of 1940, noticed halos after excitement. She was given mydriatic "drops" in the course of a refraction in the middle of September, 1940. Even during the waiting period in the physician's office, and that evening, she had a headache. She consulted her physician three days later, and was treated with "drops." Two weeks after initiation of treatment, the right eye was operated on. During the hospitalization period, the tension in the left eye rose to 57 mm. Hg (Schiötz). It was reduced by the use of miotics but rose again, requiring surgery.

Case 15. A woman, aged 54 years, on November 3, 1939, after weeping, noticed blurring and pain in the right eye, which was followed by headache and vomiting. Three days after the onset treatment with miotics reduced the tension to normal. The left eye was not affected at any time. Provocative dilatation of the pupil of the left eye caused an acute ocular hypertension.

time	*pupil size mm.*	*drug used (1 drop)*	*tension (Schiötz) mm. Hg*
0	3.0	2 % euphthalmine	18
45 min.	5.5		18
1¼ hrs.	5.5	1 % paredrine	18
1¾ hrs.	6.0		18
3¼ hrs.	6.5		60
		0.25% eserine	
3¾ hours.			15

Case 16. A man, aged 69 years, experienced his first attack of glaucoma one afternoon in 1938, with pain and headache on the left side of the head, successfully relieved by the application of heat. Five days later, shortly after awakening, another attack occurred. The eye was not red until later in the day. The pain and blurring of vision which were present at the onset continued less severely for five weeks before the patient was seen at the Infirmary. Miotics were ineffective, and a

trephining was done. The right eye had a tension of 52 mm. Hg (Schiötz) on one occasion (July 3, 1940) but was promptly normalized with miotics. The eye was not red at that time. Provocative dilatation of the pupil of the right eye with paredrine and homatropine solutions was ineffective in raising the tension above 21 mm. Hg. The pupil could not be dilated beyond 4.5 mm.

Case 17. A woman, aged 50 years, had her first attack of glaucoma in the right eye, in December, 1934. The eye became painful but was not red. The attack was relieved spontaneously but recurred intermittently. She was seen on January 28, 1935, at the Infirmary, where a diagnosis of acute "inflammatory" glaucoma was made. The eye was not red. No halos were present. The vision had been blurred for four days. An iridotasis operation was performed on the right eye on February 2, 1935. In June, 1940, the patient was hospitalized because of suspected glaucoma in the left eye. Because there was no history of redness of the other eye, the resident noted that the diagnosis on the first occasion must have been incorrect and that the diagnosis should be "chronic compensated glaucoma." Provocative dilatation of the left eye with euphthalmine on one occasion and homatropine on another, was ineffective in raising the tension. The pupil could not be dilated beyond 5.5 mm.

Case 18. A woman, aged 45 years, experienced the first ocular symptoms in July, 1940, while viewing a movie. The eye was not red, but the vision was blurred. Reading frequently caused blurring of vision. When first seen at the Infirmary in December, 1940, the tension was 70 mm. Hg (Schiötz) right, and 46 mm. left. Both eyes were pale. Miotics caused reduction of tension to normal within 30 minutes. On December 21, 1940, after being asked not to use the prescribed pilocarpine in the right eye that morning, the patient's tension was 60 mm. right, and 28 mm. left. Miotics reduced the tension of the right eye from 60 to 24 mm. Hg within 20 minutes. Provocative dilatation of the pupil of the left eye on January 9, 1941, caused a rapid rise in tension.

time min.	*pupil size mm.*	*tension (Schiötz) mm.*	*drug used (1 drop)*
0	3	28	euphthalmine 2%
15	4	43	
30	5	60	

Case 19 (outpatient). A man, aged 39 years, on October 28, 1940, after homatropine refraction, had an intraocular tension of 25 mm. Hg right, and 46 mm. left. No injection was present. Provocative dilatation of the pupil of the left eye with 2-percent euphthalmine solution for two hours was ineffective in raising the tension. The pupil did not dilate beyond 4.5 mm. On the following day the test was repeated, using 2-percent homatropine hydrobromide solution. In two hours the tension of the left eye was 60 mm. Hg (Schiötz). This was promptly reduced with miotics. Provocative dilatation of the pupil of the right eye with homatropine solution was ineffective in raising the tension.

Case 20. A man, aged 59 years, had a sudden onset of pain in his left eye three weeks before admission to the Infirmary on October 9, 1939. He had seen no halos, and the eye had become red after one week of symptoms. When seen at the Infirmary both eyes were involved. The left eye was pale. Tension in the right eye was 48 mm. and in the left eye 60 mm. Hg (Schiötz). Both eyes were relieved with miotics but subsequently had further elevations of tension, requiring bilateral surgery.

Case 21. A woman, aged 58 years, in

December, 1939, had had a cycloplegic refraction at another hospital. That same night she awoke at 2:00 a.m. with headache, pain in the right eye, slight injection of the eye, halos, and later nausea and vomiting. A day or two later treatment was sought. When seen at the Infirmary on December 28, 1939, the tension in the left eye was 56 mm. Hg (Schiötz). Miotics were only temporarily effective and recourse was had to surgery. Tension in the right eye remained normal under miotics.

Case 22. A woman, aged 39 years, for three years before being seen at the infirmary had experienced pain in her left eye about three times weekly, sometimes associated with excitement, sometimes after attendance at the movies. The pain usually lasted overnight and was never associated with redness of the eyes. On June 24, 1939, a homatropine refraction was done, following which the tension was found to be 40 mm. right and 80 mm. Hg (Schiötz) left. The eyes were pale. Miotics reduced the tensions to normal within an hour. Provocative dilatation of the pupil of the left eye subsequently caused an acute ocular hypertension, yet the eye remained free of any injection.

time	*pupil size*	*tension (Schiötz)*	
min.	*mm.*	*mm.*	*drug used (1 drop)*
0	1.7	26.0	*2%* euphthalmine
20	4.5	37.5	
40	4.5	57.0	

Case 23. A man, aged 44 years, two months before the onset of a severe attack of acute glaucoma, noticed halos after attending a movie. They had disappeared by the following morning. The eye was not red. On the night of December 19, 1940, the patient did not sleep well. At 10:00 a.m. the next day the right eye was very painful and swollen. Miotics given the following day were ineffective in reducing the tension. An iridectomy was performed on the fifth day. Two separate attempts to provoke acute glaucoma by dilatation of the pupil of the left eye with euphthalmine, paredrine, and homatropine solutions were unsuccessful. The pupil could not be dilated beyond 6.5 mm.

Case 24. A woman, aged 51 years, for several months previous to being seen at the Infirmary on February 21, 1938, had noticed that attendance of movies or reading made her uncomfortable. A week before admission her right eye was red and painful on awakening one morning. The symptoms continued for a week. When seen at the Infirmary, miotics were ineffective in reducing the tension of 60 mm. Hg. An iridectomy was performed four days later.

Case 25. A man, aged 65 years, on August 19, 1937, awoke with pain in the left frontal region and poor vision. He was seen that day at the Infirmary. The ocular tensions were 48 mm. right and 66 mm. Hg (Schiötz) left. Miotics were ineffective and both eyes were operated on.

Case 26. A woman, aged 73 years, in May, 1937, following the death of her husband in an accident, experienced smoky vision, pain, and vomiting. The symptoms cleared overnight. In October, 1937, a severe spontaneous attack of glaucoma occurred, with blindness, headache, pain, nausea, and vomiting. After being treated for 10 days for what was believed to be gall-bladder disease, the patient was seen by an oculist, who operated on both eyes.

Case 27. A man, aged 21 years, had experienced blurring of vision, pain, and often slight injection of the right eye intermittently about twice weekly since the age of 17 years. These episodes usually occurred after attendance at the movies or after reading, and usually at night. On

November 29, 1938, a homatropine refraction was done at the Infirmary. The pupil of the right eye never returned to its normal diameter. Two days after the refraction the patient began to have pain and slight injection of the right eye. When seen at the Infirmary, four days later, the tension in the right eye was 60 mm. Hg (Schiötz). The eye was only slightly injected. Miotics were ineffective in reducing the tension to normal. Surgery was necessitated.

Case 28. A man, aged 68 years, in August, 1938, experienced an acute attack of pain and visual loss in the left eye which required surgical treatment. A year later the vision in the right eye became blurred (the eye was not painful) for a day or two and spontaneously recovered but there were spontaneous recurrences of poor vision on three or four occasions. On August 12, 1939, the symptoms recurred. Miotics were used successfully. An iridotasis was performed on September 13, 1939.

Case 29. A man, aged 42 years, had for five years noticed blurring of vision, ocular pain, and occasionally halos about lights following attendance at the movies. He said that he found that these symptoms were relieved upon looking at a bright light for a while. On January 15, 1940, he was seen at the Infirmary. The intraocular tensions were 48 mm. Hg (Schiötz) right and 18 mm. left. The use of eserine reduced the tension in the right eye to 15 mm., within two hours. On April 27, 1940, dilatation of the pupil of the right eye with one drop of euphthalmine produced an increase in tension as follows:

time hrs.	*tension (Schiötz) mm. Hg*	*drug used (1 drop)*
0	15	2% euphthalmine
1	31	
2¼	43	
3	43	

Provocative dilation of the pupil of the left eye with 1-percent paredrine and 2-percent homatropine solutions was ineffective in producing glaucoma. The pupil was dilated to 7 mm.

Case 30. A woman, aged 68 years, experienced her first attack of ocular pain in the left eye in April, 1939. This was relieved by "drops" but recurred five times. On December 12, 1939, another attack occurred. A diagnosis of acute iritis was made, and the patient given atropine. Four days later the tension in the left eye was 82 mm. Hg (Schiötz). Miotics were rapidly effective. On July 22, 1940, after forgetting to use pilocarpine, the patient had an intraocular tension of 43 mm. Hg, but has been normal on pilocarpine since.

Case 31 (outpatient). A woman, aged 41 years, in August, 1937, began to have headaches over the left eye, blurring of vision, and later slight injection and vomiting. This attack, which did not start with redness, lasted one week and recurred a week later. On being seen at the Infirmary on September 14, 1937, the tensions were 58 mm. right and 40 mm. Hg (Schiötz) left. Miotics were rapidly effective in reducing the tension to normal. This patient had experienced discomfort but no halos on prolonged reading. Provocative dilatation of the pupil of the left eye with 1 drop of 2-percent euphthalmine solution was ineffective. The pupil did not dilate beyond 4 mm. A similar test on the left eye with paredrine and homatropine gave the following results:

time hrs.	*pupil size mm.*	*tension (Schiötz) mm. Hg*	*drug used (1 drop)*
0	1.5	23	1% paredrine
0.5	3.5	23	
1	4.5	23	2% homatropine
1¾	5.5	37.5	
2	5.5	50	
2½	5.5	57	2% pilocarpine
3	5.0	43	

Case 32. A man, aged 67 years, awoke one morning with blurring of the vision of the right eye, slight injection of that eye, and slight headache. He went to the Infirmary the next day, after the eye had become worse. It was then red and the tension 70 mm. Hg (Schiötz). Miotics were only temporarily effective and later required surgery. Provocative dilatation of the pupil of the left eye was ineffective in causing glaucoma. The pupil could not be dilated beyond 5 mm.

Case 33. A man, aged 71 years, one evening, seven years ago, had experienced an irritative pain in the left eye, without any associated redness of the eye. The pain became worse the next morning, and a physician was consulted. The patient was seen at the Infirmary three weeks after the onset of the symptoms. Miotics were ineffective. The other eye was normal until February 5, 1937, when the right eye became painful and vision was blurred, but the eye was not red. The next day the eye was red when the patient was seen at the Infirmary. Eserine was effective in reducing the tension to normal but it rose again subsequently, requiring iridectomy.

Case 34. A man, aged 58 years, on January 1, 1939, saw halos and had pain in his right eye and on the right side of the head after reading for a short time. The eye became red. The symptoms lasted until the next night. These symptoms recurred six times, always associated with reading. On the evening of April 6, 1939, the right eye became painful and injected and halos were seen. When he came to the Infirmary, two days later, the tensions were 65 mm. right and 41 mm. Hg (Schiötz) left. Eserine reduced the tensions to normal rapidly.

Case 35. A woman, aged 64 years, during an acute coryza in February, 1939, one evening experienced sudden pain in her left eye and nausea. The eye was not red until the next morning, when it was slightly injected, but became quite red in three days. She was then seen by an oculist, who used miotics in both eyes. Apparently the right eye was also involved, but the symptoms of the other eye had obscured those of the right one. The right eye was never red. When seen at the infirmary on March 30, 1937, the tension in the left eye was 66 mm. Hg (Schiötz). Miotics were effective in reducing the tension. Surgery was performed on April 2, 1937. Provocative dilatation of the pupil of the right eye with 1-percent paredrine-hydrobromide solution was ineffective. The pupil could not be dilated beyond 5.0 mm.

Case 36. A woman, aged 50 years, said that her right eye had been involved with acute glaucoma 10 years ago, when she was given "drops" for refraction. The vision became blurred an hour later. She saw no halos but experienced nausea and vomiting. The eye became red in two days. It was treated medically for three weeks and then operated upon. Vision in the left eye became spontaneously blurred; the eye was painful but not red on July 4, 1938. Nausea and vomiting were present. When seen at the Infirmary the same day, the tension was 52 mm. Hg (Schiötz). The eye was not red. The tension was reduced to normal with eserine within a short time.

Case 37. A man, aged 69 years, said that in July, 1937, vision in his right eye became blurred, and the eye was painful but not red. The pain disappeared in 36 hours. A second attack occurred one week later. The vision was blurred for two or three days. He could not remember if there was redness. A third attack occurred a few days before he was seen at the Infirmary on July 27, 1937, with pain and blurring of vision. Eserine was rapidly effective. On May 31, 1938, the patient was admitted with pain, redness of the

right eye, and a tension of 77 mm. Hg. Miotics were ineffective, and an iridectomy was performed on June 3, 1938. One-percent pilocarpine-nitrate solution was ordered for the left eye as a prophylactic measure. On June 3, 1939, after forgetting to use his pilocarpine solution, the patient had an acute attack of pain, decreased vision, and redness of the left eye. The next morning he was nauseated. Four days later he was seen at the Infirmary. The eye was soft and showed evidence of a subsided acute attack with irregular pupil, wrinkling of Descemet's membrane, and large pigment granules on the posterior corneal surface. Provocative dilatation of the pupil of the left eye was successful in inducing an acute ocular hypertension without any vascular congestion.

time hrs.	*pupil size mm.*	*tension (Schiötz) mm. Hg*	*drug used (1 drop)*
0	3.0	15	1% paredrine
0.25	4.5	15	1% paredrine
1¼	4.5	15	1% paredrine
2	4.5	15	2% homatropine
2¾	6.5	26.5	
3	6.5	30.5	
3¼	6.5	35	
3½	6.5	40	
3¾	6.5	52	

Case 38. A woman, aged 48 years, said that eight years ago, four or five hours after extraction of 14 teeth at one sitting one afternoon, she began to have pain and redness of the left eye. This attack was relieved with "drops." Two weeks later another attack occurred, An iridencleisis operation was performed. The patient came to the infirmary in 1936 because of pain in her right eye when she crocheted. Attacks of pain recurred intermittently and became more frequent. A cyclodialysis was performed on the right eye on June 10, 1940, but no opening was visible. The tension remained normal until August 12, 1940, when another attack occurred which was relieved by hot applications. On November 4, 1940, tension in the right eye was 60 mm. Hg. It fluctuated considerably with miotics. On November 16, 1940, the patient began to have pain in the right eye, blurring of the vision, and photophobia. The eye was red. The tension was 60 mm. Hg. Miotics were ineffective, and nine days later an iridectomy was performed.

Case 39. A man, aged 66 years, was seen at the Infirmary on November 21, 1935. The anterior chambers of both eyes were very shallow. The tensions were 70 mm. Hg right, and 12 mm. Hg left. The eyes were not red. Miotics were effective. On July 13, 1937, the tension in the right eye was 70 mm. Hg. An iridectomy was performed that day. On August 18, 1938, the patient's left eye became painful and his head ached. He used the pilocarpine he had used for the other eye. A week later when seen at the Infirmary the tension in the left eye was 82 mm. Hg. An iridectomy was performed after the use of miotics had proved vain.

Case 40. A man, aged 61 years, in July, 1939, after supper, experienced aching of the right eye without blurring of vision or redness of the eye. He awoke the next morning with the right eye red and its vision blurred. Three or four days later he consulted a physician, who referred him to the Infirmary. Tension in the right eye was 82 mm. Hg. Miotics were ineffective. An iridotasis was performed on August 12, 1939. Provocative dilatation of the left eye with paredrine and homatropine solutions for three hours caused no increase in the tension. The pupil did not dilate beyond 6 mm.

Case 41. A man, aged 60 years, was seen at the Infirmary after a diagnosis of cataract had been made. The intraocular tensions were 72 mm. Hg right, and 30 mm. left. The eyes were not red. About

six months before admission, the right eye had been irritated. Two months previously the vision had blurred, and he had noticed halos about lights. The eye had been red a month before admission. Because miotics were ineffective, a Lagrange operation was performed on the right eye. While in the hospital, atropine accidentally was dropped into the conjunctival sac of the left eye. The eye became hard, and a cyclodialysis was done after miotics had failed to reduce the intraocular tension.

Case 42. A man, aged 58 years, said that following an argument one night, vision in the left eye was dimmed and the left eye began to "pound." Five or six hours later the eye became red. The patient was hospitalized elsewhere and treated with miotics and finally operated on. In December, 1939, while at work as a night watchman, vision in the right eye became foggy, but the eye was not red. Again on January 3, 1940, he awoke with blurring of vision. The eye was not seen. Five or six hours later the eye began to "pound" and became painful. The patient was seen at the Infirmary that day and miotics were used for two weeks unsuccessfully. The eye was then operated on.

Case 43. A woman, aged 73 years, began to have ocular symptoms in October, 1935, with a sudden onset of pain in the right eye, which subsided in three days. The second attack occurred in December, 1935, but was less severe. On February 15, 1936, a third attack occurred with pain, nausea, and vomiting. The patient was seen at the Infirmary on March 7, 1936. Her intraocular tensions were 53 mm. Hg right, and 17 mm. left. Miotics were ineffective, and an iridectomy was performed three days later. On January 22, 1938, the patient was admitted because of pain and redness in her left eye, associated with decreased vision. Tension in this eye was 65 mm. Hg. Miotics rapidly reduced the tension to normal.

Case 44. A woman, aged 48 years, said that her left eye had an acute attack of glaucoma after she had been weeping over the death of a child. The vision was blurred and the eye was painful but not red until the next day. After medical treatment an iridectomy was performed. On June 15, 1939, following an emotional disturbance, the intraocular tension in the patient's right eye was elevated. Again on January 31, 1940, it was 52 mm. Hg. The eye was pale on both occasions. On May 13, 1940, during a "cold" the patient began to have pain and decreased vision at about 3:00 or 4:00 p.m. (no statement as to redness). The following morning the tension in the right eye was 80 mm. Hg. Miotics were used ineffectively and recourse was had to surgery.

Case 45. A man, aged 56 years, three weeks before being seen at the Infirmary on April 19, 1939, experienced blurring of vision in the right eye, without pain, halos, or redness. When seen the tensions were 19 mm. Hg right, and 65 mm. left. A drop of pilocarpine rapidly reduced the tension to normal. On four occasions during 1939 the tension in the right eye was elevated to 40 or 48 mm. Hg, and always rapidly reduced to normal with miotics. Attempted provocative pupillary dilatations on two occasions with 2-percent euphthalmine and 2-percent homatropine solutions were ineffective. The pupil was dilated to 7 mm.

Acute Glaucoma Associated with Intumescent Cataracts

Case 46. A man, aged 21 years, first became aware of having a cataract in the right eye in November, 1940. There was no history of trauma. Although there was glaucoma with high intraocular tension and shallow anterior chamber, the eye

remained pale. Miotics were effective in reducing the tension. A right linear extraction operation was performed on December 2, 1940.

Case 47. A woman, aged 75 years, said that her right eye was painful for a week in December, 1938. The pain recurred intermittently. When seen at the Infirmary on March 27, 1939, the tension in the right eye was 60 mm. Hg (Schiötz). The eye was not red. Miotics reduced the tension to normal within about two hours. The anterior chamber was rendered shallow by an intumescent lens. At the time of operation of the right eye, cocaine, used for anesthesia, precipitated another episode of high intraocular tension. Miotics were used and reduced the tension to normal within 30 minutes. The lens was then removed. An expulsive hemorrhage followed that evening.

Case 48. A woman, aged 78 years, was seen on July 8, 1938, after a progressive decrease in the vision of the right eye during the previous year. The tension in this eye was 40 mm. Hg (Schiötz). The lens was intumescent and the chamber markedly shallow. Miotics were ineffective in reducing the tension to normal, so an iridectomy was performed on July 16, 1938.

Case 49. A woman, aged 49 years, had had progressive visual loss because of bilateral cataracts for the past three years. She was seen on June 20, 1939, with a history of sudden pain in the right eye for two days. There was no redness of the eye, and miotics were effective in normalizing the tension. An extracapsular extraction of the intumescent lens was performed on the right eye on June 28, 1939.

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Discussion

Dr. Harry S. Gradle: This splendid paper presents the results of careful observation of a large number of cases and thoughtful analysis of the problems they implied. The theme is a plea for a reclassification of glaucoma based upon the

major factor of depth of the anterior chamber and more especially the angle of the anterior chamber.

The idea is not new, for, as Dr. Sugar has shown, there have been references in the literature to such a possible classification, but lacking the gonioscopic evidence he presented. Some 20 years ago, Dr. Walter Parker told me in a personal communication that he was basing the type of surgery he used in simple noncongestive glaucoma upon the depth of the anterior chamber. This was entirely the result of clinical experience. In deep-chamber glaucoma, he performed a filtering operation, whereas if the case presented a shallow chamber, he preferred an iridectomy. That observation of fully two decades ago corroborates Dr. Sugar's plea.

I believe that an acute incompensated (congestive) glaucoma is a disease different from a compensated (simple noncongestive) glaucoma, etiologically, clinically, mechanically, and therapeutically. The congestion represents the failure of compensation of the vascular apparatus of the eye, the inability of that system to become adjusted to the sudden increase in intraocular pressure by the mechanical blockage of the drainage outlets. As Dr. Sugar has shown so well, the advent of hypertension precedes the congestion, as would be expected. But in compensated glaucoma (I prefer that term to simple noncongestive) the onset of hypertension, whatever the unknown cause may be, is slow and there is a compensatory action of the vascular apparatus of the eye that persists until the threshold of that possibility has been overstepped. Then and only in the late stage, does decompensation result, and the eye becomes red. However, during the course of a compensated glaucoma, a sudden increase in pressure may occur as the result of an emotional disturbance, then a break in compensation can occur and congestion appear. In such cases, there has been a sudden mechanical blockage of the chamber angle that did not exist before the break in compensation.

For the last three years, I have published and maintained that the terms "primary" and "secondary," as applied to glaucoma, are used only because of our ignorance, and would disappear from our hypertension lexicon as we learned more and more about the cause of the conditions. In the third volume of his magnificent textbook, Duke-Elder expressed the same view. In the future, I believe that intraocular hypertension will be designated from the standpoint of etiology and clinical manifestation. A step in that direction has been made for example in the term "capsular glaucoma." Probably more than 10 percent of the cases that in the past we designated as glaucoma simplex, or simple noncongestive glaucoma, or compensated glaucoma are in reality cases of intraocular hypertension without manifestations of congestion, and are due to exfoliations of the anterior capsule of the lens. As our knowledge increases, the etiologic factor will be found in more and more cases and will be reflected in the terminology of the condition. Then the terms "primary" and "secondary" will be relegated to the limbo of "cryptogenetic" and "idiopathic."

So I agree with Dr. Sugar that a reclassification is necessary, but the question is, do we know enough yet to make it? In view of the enormous gaps in our knowledge of the etiology, we certainly cannot discard from our terminology such designations as show the clinical aspects of the condition, but we may well supplement them by the inclusion of terms describing the very important phase of chamber depth.

MARBLE BONES AND OPTIC ATROPHY*

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In 1879 Hueck[1] described bony sclerosis at autopsy in a case of leukemia. This was later classified as osteosclerosis, and then called marble bones in 1904 by a roentgenologist of Hamburg named Albers-Schönberg,[2] who first described the bony changes in the living roentgenologically. The condition is still called Albers-Schönberg's disease, but in 1926 Karshner[3] objected to the appellation of marble bones and coined the term osteopetrosis or "brittle bones."

Optic atrophy in Albers-Schönberg's disease was first definitely reported by Sick[4] in 1914, in a family in which three siblings and a cousin all had marble bones and optic atrophy. Although the 118 cases[5] of osteopetrosis that have appeared in the medical literature up to August, 1940, include a high percentage of optic atrophy, this is the first discussion of the disease from the ophthalmological viewpoint.

To illustrate the advisability of such a discussion, I shall give a brief clinical abstract of a case reported by Drs. Clifton, Frank, and Freeman[6] from the Children's Memorial Hospital, in 1938.

E. C., a boy now eight years old, was one year old when he was brought to the eye clinic at Children's Memorial Hospital in July, 1933, because of blindness present for six months. Our examination showed bilateral primary optic atrophy plus secondary findings of fixed pupils and a rolling nystagmus. Syphilis was suspected, but the Wassermann test was negative. During the next three years the boy was seen many times in the oto-laryngological clinic because of profuse purulent nasal discharge. He also had arrested dentition, and frequent infections of the respiratory tract. He had a stocky build, square forehead, pigeon breast, and bowed legs.

Finally, in September, 1936, when the boy was four years old, the picture completed itself. He was brought in to the clinic because of inability to elevate the right shoulder. A roentgenogram then revealed the markedly increased density of all the bones of the shoulder girdle. The diagnosis of osteopetrosis was confirmed by roentgenograms of the remainder of the bones, which demonstrated the marked increase in density of all the bones of the skeleton (fig. 1). There was a broad flaring of the ends of the long bones, giving a dumbbell-like appearance. The shadows of the marrow cavities were greatly reduced. On the long bones, one also saw alternating transverse bands of greater and lesser density parallel to the epiphyseal lines. The bones of the base of the skull (fig. 2) were very dense and there was the clublike thickening of the posterior clinoid processes (fig. 3) described by Albers-Schönberg,[7] in 1907.

Narrowing of the foramina of the skull had been shown in osteopetrosis at autopsy by Lorey and Rye,[8] Kraus and Walter,[9] and by Alter, Pease, and De Sanctis.[10] In 1934, McCune[11] reported that attempts to demonstrate this roentgenologically had been unsuccessful, as did Lamb and Jackson,[12] in 1938. This case (figs. 4, 5), first reported in 1938 by Clifton *et al*, and a case reported by Vigdoff and Bracher[5] in August, 1940, are the only articles I could find that show the

* From Children's Memorial Hospital, Chicago. Read before the Chicago Ophthalmological Society, October 21, 1940.

optic foramina roentgenologically in osteopetrosis. This encroachment on the optic foramen is generally credited with causing the optic atrophy.

Hydrocephalus is also a common complication in children with osteopetrosis and may be due to general constriction of the cranial ostia with obstruction of venous outflow. While numerous reports of this complication are found, including cerebrospinal-fluid pressures up to 620 mm. of water,[8] only one report of papilledema was noted in hydrocephalus complicating osteopetrosis. Laurell and Wallgren[13] described a 12-year-old boy whose vision began to fail in his second year, and who had bilateral choked discs in an atrophic stage. His cerebrospinal pressure was 330 mm. of water, which fell to 220 after withdrawal of 10 c.c. of fluid. While strabismus, ptosis, anisocoria, nystagmus, tortuosity of the retinal vessels,[14] and even hypertelorism[15] are complications reported in the literature, optic atrophy is the most common ocular report and is generally found to be present early in childhood in osteopetrosis.

Fig. 1 (Riser). Pelvis and femurs. Note the increased density, the clubbing of the ends of the long bones, and the alternating lines of increased and decreased density parallel to the epiphysis (E. C.).

Fig. 2 (Riser). Note the heaviness of the bones of the face (E. C.).

Clifton and co-workers were able to find roentgenograms of their patient's chest taken, when he was only 10 days old, because of thymic convulsions. These show the bones to be denser than normal. Again at 10 weeks, after two X-ray treatments to the mediastinum, roentgenograms were taken and showed the trans-

Fig. 3 (Riser). Shows clubbing of the posterior clinoid process (E. C.).

verse band in the metaphysis at the proximal end of the humerus. These pictures proved that osteopetrosis existed so early that the process must have begun *in utero*. Indeed, Pirie[16] has roentgenograms showing the disease *in utero*. He felt that the bones of Albers-Schönberg's disease resemble chalk rather than marble because they yielded readily to instrumentation and were very brittle. However, Du Pont[17] insists (on autopsy findings) that the sclerosed bone is abnormally hard with areas of rarefaction interposed. He claims that it is through these lines of rarefaction that fractures occur.

Our patient has had a number of pathological fractures which show characteristic healing with heavy callus formation. The blood picture has been essentially normal, showing only a mild anemia, which substantiates the opinion that this osteosclerosis is of the "marble bone" type in which the essential lesion is one primarily of excessive bone formation

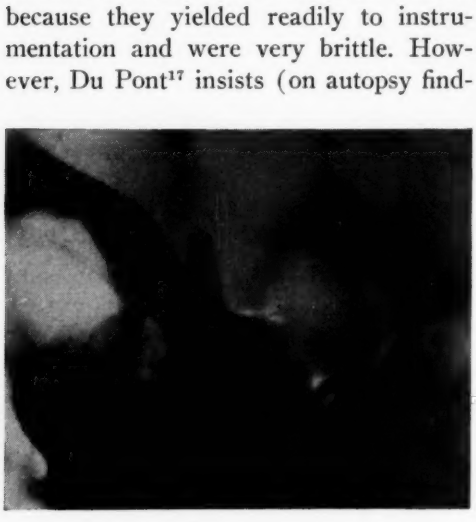

Fig. 4 (Riser). The optic foramen in the patient, E. C.

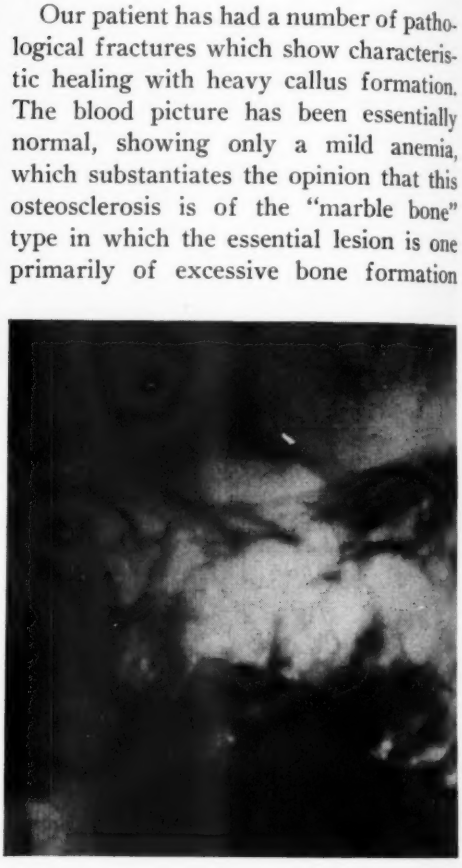

Fig. 5 (Riser). Normal optic foramen, same age.

with gradual thickening of the cortex and encroachment on the medullary cavity. It usually occurs in childhood, persists throughout life into adulthood (if reached), is often associated with blindness beginning early in life, and only late in its course develops a terminal myelophthisic anemia. The detailed report of this case by Clifton and co-workers describes the microscopic findings of biopsy of rib and tibia and the chemical analysis

of the bones, as well as the results of the calcium-balance studies made during a long stay in the Children's Memorial Hospital. Since I am stressing the ocular picture of osteopetrosis, I must refer you to the above-mentioned study and to Karshner,[3] Pirie,[16] McCune,[11] and to the latest report, that of Vigdoff and Bracher[5] (case no. 118), to give you a more general picture. Although Reiche,[18] in 1915, further delineated the clinical picture by excluding those cases in which leukemia was the primary factor, mention should be made briefly of the other type of osteosclerosis, which is one of myelosclerosis or myelofibrosis, occurring after the second decade, showing a leukemoid blood picture, an enlarged spleen, severe anemia, and no optic atrophy. I found no record of an adult with osteosclerosis and optic atrophy in whom the poor vision had not been present since very early childhood.[4, 5] The pathology in this adult leukemoid type is in the medullary cavities, consisting of fibrosis with some bone formation. The case Heuck[1] described in 1879 was evidently of this type, showing a leukemia in which the bone marrow at autopsy was encroached upon by a network of fibrous tissue and by fine long trabeculations. This was later classified as osteosclerosis, and similar cases have been reported under both the osteoporotic and osteosclerotic headings. Herscher and Stein[19] in 1940 reported a case of marble bones associated with Hodgkin's disease which was more typical of the second type of osteosclerosis, and which showed no ocular pathology. This last fact is emphatically typical of the more adult type of osteosclerosis associated with leukemoid blood pictures, for they do not show optic atrophy.

The typical osteopetrosis is found to be associated with infancy or early life, and the case histories stress the findings of blindness and nystagmus. In analyzing the reported cases, I found many otherwise complete histories in which data regarding the eyes and vision were omitted entirely and others in which optic atrophy was taken as a matter of course and an essential part of the picture of osteopetrosis. I found practically all patients reported after the age of 15 to have good eyes while a large percentage of those under 10 years of age had optic atrophy, if the eyes were described at all. This fits in with the two types of osteosclerosis mentioned previously, and I feel one of the aids in differentiating osteopetrosis from the myelosclerotic leukemoid type of Heuck is the finding of optic atrophy.

Summary

1. Optic atrophy and associated ocular findings are very commonly found in infants and children with osteopetrosis.

2. Optic atrophy is not a feature of adult osteosclerosis.

3. An ophthalmologist, confronted by a young patient with optic atrophy and negative Wassermann test, may well advise roentgenological studies of the child's bones, for he might be dealing with a case of Albers-Schönberg's disease.

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GONORRHEAL OPHTHALMIA AND GONORRHEAL OPHTHALMIA NEONATORUM*

An evaluation of the treatment

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Gonorrheal infection of the conjunctiva usually results in a very acute conjunctivitis. When the disease is acquired at birth, or shortly afterwards, it is termed gonorrheal ophthalmia neonatorum. Duke-Elder[1] defines ophthalmia neonatorum as "a preventable disease due to uncleanliness before, and carelessness during or immediately after birth."

Incidence. In 1937 Vonderlehr and Usilton[2] of the United States Public Health Service estimated that an average of 1,037,000 cases of acute gonorrhea occurred in the United States each year, and stated that there was no evidence that the disease was on the decline in this country.

In 1935, Berens, Kerby, and McKay[3] made a study of the causes of blindness among 2,702 inmates of schools for the blind during the school year 1933-1934. They found that 3.2 percent was definitely due to gonorrheal ophthalmia neonatorum.

De Schweinitz[4] stated that ophthalmia neonatorum was the cause of 8 percent of blindness in this country, and that 60 to 70 percent of ophthalmia neonatorum was caused by the gonococcus. Collins and Mayou stated that the gonococcus was the cause of ophthalmia neonatorum in 66.6 percent of all cases.

McKee[5] stated that from 30 to 60 percent of the inmates of asylums for the blind throughout the country owed their infirmity to the ravages of ophthalmia neonatorum.

According to Parsons[6] and Duke-Elder,[1] gonorrheal ophthalmia occurs once in every 700 to 800 cases of gonorrhea. Using Vonderlehr and Usilton's annual morbidity figure for gonorrhea of 1,037,000 cases, there is obtained the figure of 1,926 new cases of gonorrheal ophthalmia each year in the United States.

The data on which this thesis is based were taken from the case records of the Cincinnati General Hospital and the Children's Hospital of Cincinnati for the years 1923 to 1938, inclusive, and the first half of 1939. A total of 115 cases of gonorrheal ophthalmia, and 126 cases of gonorrheal ophthalmia neonatorum was reviewed. Only proved cases of each were included.

From five hospitals in other cities statistical information was obtained concerning 293 cases of gonorrheal ophthalmia neonatorum, and 307 cases of gonorrheal ophthalmia, occurring during the years 1927 to 1937, inclusive. Additional nonstatistical information was received from seven hospitals treating gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum in other cities.

Nature of the disease. Although primarily an infection of the conjunctiva, the complications constitute the most serious aspect in patients of all ages. The most common complication is corneal ulcer, which, if it perforates, frequently results in loss of vision in the involved eye.

In the newborn[7] the conjunctiva is especially prone to infection because of the absence of tears, and the absence[8] of a

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conjunctival layer of lymphoid tissue. This lymphoid layer rapidly accumulates after inflammation starts.[1] If silver-nitrate solution is instilled at birth, this layer of lymphoid tissue forms in about a week. Ordinarily[7] it develops during the first four weeks.

The newborn conjunctival epithelium[8] consists of but two layers, whereas in the adult palpebral conjunctiva are usually found numerous areas where the epithelium consists of many layers that cannot be regarded as pathological. The conjunctival epithelium of the newborn is thinner and not so flattened as in the adult.[7] In the fornices it undergoes considerable mucoid and desquamative changes, laying bare the basement membrane and affording microorganisms an easy entrance.

The gonococci penetrate the superficial layer of conjunctival epithelium in vast numbers, and are found in desquamated epithelial cells and pus cells in the discharge. Many gonococci penetrate to the deeper layers, and sometimes[1] are found in groups in the subconjunctival tissues. At the same time gonococci invade the cells of the corneal epithelium, the number in this tissue being about half that found in simultaneous scrapings from the conjunctiva.

Treatment

Rationale of treatment. The prime object of treatment in gonorrheal conjunctivitis, as in all diseases, is to assist the natural body defenses in overcoming the infection, and to prevent complications. More specifically the task resolves itself into keeping the conjunctival sac clear of discharge, the reduction of swelling in the lids and conjunctiva, preventing the other eye from becoming infected, and preventing the spread of the disease to the attendants and to other patients.

Treatment requisites. All cases of gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum should be isolated. A special isolation unit in the eye division of a general hospital has advantages over a special eye hospital, or a contagious-disease hospital. In a general hospital the coöperation of the pediatric department is of value in regulating feeding schedules, and keeping the babies' resistance powers at an optimum. The constant supervision and alertness of ophthalmologic residents, and the facilities for coping with ophthalmologic emergencies are usually lacking in contagious-disease hospitals.

An efficient nursing instructor and supervisor is essential in training nurses in the exacting and painstaking routine necessary. Her loyalty, thoroughness, and devotion to duty constitute an important factor in the successful treatment of this disease.

The nursing care and treatment must be on a 24-hour schedule for patients of all ages. The nurses should wear masks, gloves, and gowns in the strict observance of isolation technique. Goggles are advisable to protect the eyes of nurses and doctors from squirting discharge when swollen lids are opened. The nurses' and doctors' fingernails should be filed short to avoid bruising the cornea through the lids. Small pieces of cotton should be used to open slippery lids, avoiding all pressure on the globe. Desmarre lid retractors should be used only by the doctor, who should inspect the cornea daily.

Protection of the uninvolved eye. The Buller shield is not entirely effective in preventing infection of the other eye in adults, and is impracticable for babies. Three large well-known hospitals in other cities reported that they did not use Buller's shield, having found it ineffective. A fourth used it in adults but found it unreliable. Seven hospitals reported that they found it effective in adults.

In the Cincinnati General Hospital,

Buller's shield was used and found effective in adults. As a substitute, the uninvolved eyes of babies were protected by a dikelike fin of adhesive tape built along the bridge of the nose and half way up the forehead. Patients of all ages were kept on their backs, or on the side of the involved eye. The babies' arms were splinted and pinned to their sides to keep them from rubbing their eyes. In the few monocular cases of gonorrheal ophthalmia neonatorum, the other eye seldom became infected.

Edema of the lids and conjunctiva. When a case of gonorrheal ophthalmia or of gonorrheal ophthalmia neonatorum was admitted with tightly swollen lids, external canthotomy was done at once. This was found necessary to allow cleansing of the conjunctival sac, to relieve the pressure of the swollen lids on the cornea, and to permit adequate inspection of the cornea. The procedure is advocated by most writers on the subject. In our cases it was rarely necessary in gonorrheal ophthalmia neonatorum.

Pericorneal chemosis of the bulbar conjunctiva was seen frequently in children and adults, rarely in infants. According to Fuchs,[9] de Schweinitz,[4] Parsons,[6] and McKee,[5] it frequently has caused corneal ulcers by pressing on the marginal loops of the conjunctival vessels, thus impairing corneal nutrition. The chemotic conjunctiva formed a trough in which the discharge collected, and often overlapped the cornea, promoting maceration of the epithelium. The unanimous recommendation was scarification of the chemotic bulbar conjunctiva.

In this series of cases, multiple radial circumcorneal incisions were made with scissors under cocaine anesthesia. Sometimes this was done on two or three successive days. Following this treatment, corneal infiltration cleared up and small ulcers usually healed promptly. The incisions were made deep enough to obtain free bleeding. In no case were any conjunctival scars visible when the patient was discharged.

The application of leeches to the temple near the external canthus has been recommended by the older writers to reduce lid swelling.

Conjunctival irrigations. Irrigating the conjunctival sac to remove the discharge is one of the cardinal principles of treatment of both gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum.[1] Various solutions and methods of irrigation have been advocated and used. The solution should be mild and non-irritating. The avoidance of trauma should be constantly and religiously observed. The introduction of irrigating nozzles into the conjunctival sac is fraught with the danger of injuring the corneal epithelium, should the patient move his eye unexpectedly. The irrigating solution should not be directed at the eye with any force, to avoid abrading the corneal epithelium already macerated by the discharge.

An undine held an inch above the eye, with the stream directed on the everted lids, or into the cul-de-sacs, was used routinely every two hours when necessary in the treatment of cases at the Cincinnati General Hospital. Between irrigations, when necessary, the lids were gently wiped off with pieces of cotton soaked in the irrigating solution, which was allowed to trickle between the lid margins.

As irrigating solutions, normal saline,[6, 10, 11] saturated solution[4, 5, 10, 11] of boric acid, mercuric-chloride solution[4, 6, 11] one grain to the pint, potassium-permanganate solutions 1:2,000 to 5,000,[4, 9] formaldehyde 1:5,000, cyanide of mercury 1:1,500 to 5,000, have been used by various ophthalmologists. In this series of cases potassium permanganate 1:5,000 to 10,000 at body temperature was used as

an irrigating solution in 83.7 percent of cases of gonorrheal ophthalmia and in 90.2 percent of cases of gonorrheal ophthalmia neonatorum. In the remaining cases, either normal saline or 5-percent of boric acid was used. There was no appreciable difference in the duration of hospitalization, nor in the numbers developing corneal ulcers in these two groups of cases. Parsons thought that potassium-permanganate solution had a harmful effect on the corneal epithelium.

Boric-acid solution was used for irrigating the conjunctival sac in 9 out of 12 hospitals in other cities. Reports from the other three hospitals did not state what irrigating solution was used. All stressed the importance of irrigating often enough to keep the discharge in the conjunctival sac at a minimum.

Duke-Elder[1] advocated a buffered solution of the same reaction as that of the conjunctival secretion. He stated that the lysozyme of the tears was destroyed by free acid or alkali.

Iced compresses. The application of iced compresses to the lids is a valuable procedure to promote comfort and reduce swelling. McKee[5] thought that they should be applied constantly for 20 minutes every hour, day and night, in the first stage. De Schweinitz[4] varied the frequency from almost continuously in severe cases, to 20 minutes every three or four hours in the less severe. He found no increase of corneal complications when this technique was used. Gifford[10] advised the use of iced compresses to the lids for at least one half of the time between irrigations, but thought they should not be continued longer than the first 24 to 48 hours. Parsons[6] stated that iced compresses afforded much relief to the patient but that hot compresses probably were more efficacious. Fuchs[9] used iced compresses in the first stage, continuously or at short intervals, depending upon the effect produced on the lid swelling. In the first stage May[11] used iced compresses "more or less continuously" day and night.

A modification of the method of applying iced compresses used by de Schweinitz was used in the Cincinnati General Hospital. Instead of gauze compresses, flakes of absorbent cotton, large enough to cover both lids, were moistened in sterile water and laid on a lump of ice in a basin. After two or three minutes they were laid on the closed lids and changed every minute or two. The used one was discarded each time. The lid skin was protected with a thin film of sterile vaseline.

For the past four or five years the usual procedure has been to apply the iced compresses to the involved eye for five minutes out of every hour, 24 hours a day, in gonorrheal ophthalmia neonatorum. This was continued as long as the lids remained swollen, whether a corneal ulcer was present or not. In gonorrheal ophthalmia they were usually applied for 10 to 15 minutes every two hours during the first stage and gradually reduced after the swelling cleared up. Occasionally, when the iced compresses were discontinued too soon, the lid swelling and discharge returned.

During the years 1927 to 1931, inclusive, iced compresses were used continuously in 12 cases of gonorrheal ophthalmia. Of these, six, or 50 percent, developed corneal ulcers, compared with the incidence of 43.8 percent in the whole group of 105 patients admitted free from corneal involvement. During the same period, when iced compresses were used continuously in gonorrheal ophthalmia neonatorum, corneal ulcer developed after admission in 22.2 percent against 14.7 percent in the whole group of 122 patients admitted free from corneal involvement.

This evidence of the injurious effect on the cornea of excessive cold compresses,

supports the opinions of Gifford and May.

Iced compresses were used intermittently for 73 patients with gonorrheal ophthalmia admitted free from corneal involvement. Corneal ulcers developed in 30, or 41.09 percent, compared with the group incidence of 43.8 percent. It is of interest that the figure for negroes was 34.6 percent against 44.6 percent for whites.

In gonorrheal ophthalmia neonatorum iced compresses were used intermittently for 84 patients admitted free from corneal involvement. Corneal ulcers developed in 11, or 13.09 percent, compared with the group incidence of 14.7 percent. Only 6 of the 12 hospitals in other cities included iced compresses among their therapeutic measures.

Silver nitrate. Painting the palpebral conjunctiva with silver-nitrate solution 1 percent or 2 percent in the second stage of gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum has been advised by Fuchs,[9] Parsons, McKee, May, Gifford, and Duke-Elder. De Schweinitz approved its use in the first stage, as well as in the second, in the absence of a false membrane. All of these authors ascribed the virtue of the procedure to the formation of a pellicle composed of the outer layer of conjunctival epithelium. This pellicle is sloughed off in two or three hours, carrying with it vast numbers of killed intracellular gonococci. Too energetic painting was found to cause too deep a slough, and, if often repeated, increased the inflammation. They recommended painting once or twice daily as long as the profuse discharge continued.

A cotton-wrapped applicator soaked with silver-nitrate solution 0.5 to 2 percent should be brushed lightly once across the conjunctiva of the everted lids. After about 15 seconds, with the lid still held everted, the conjunctiva is washed with normal saline, boric solution, or sterile water. The applicator must not contain an excess of silver-nitrate solution that might run down and injure the corneal epithelium before it could be neutralized or washed away.

In the Cincinnati General Hospital from 1923 to 1938, inclusive, the palpebral conjunctiva was painted with silver-nitrate solution 0.5 to 2 percent in the case of 23 out of 105 patients with gonorrheal ophthalmia admitted free from corneal involvement. Of these 23 patients, 10, or 43.4 percent, developed corneal ulcers. In some cases the painting was done by nurses. When it was done by doctors, corneal ulcer occurred in only 14.2 percent. The incidence of corneal ulcer in the whole group of 105 cases was 43.8 percent.

Silver-nitrate solution 0.5 to 2 percent was instilled into the conjunctival sac, instead of painted on the conjunctiva, in the case of 30 patients in this group. That 17, or 56.6 percent, developed corneal ulcer, would seem to brand the procedure as ineffective, or even harmful, in gonorrheal ophthalmia.

During the 1923 to 1938 period the palpebral conjunctiva was painted with silver-nitrate solution 0.5 to 2 percent in the case of 32 out of 122 patients with gonorrheal ophthalmia neonatorum admitted without corneal complications. Of these 32, seven, or 21.8 percent developed corneal ulcers. When the painting was done by doctors, 21.4 percent developed corneal ulcers. The incidence of corneal ulcer in the whole group was 14.7 percent.

Silver-nitrate solution 0.5 to 2 percent was instilled into the conjunctival sacs, instead of painted on the conjunctiva, in 29 cases of gonorrheal ophthalmia neonatorum of the above group. Corneal ulcers developed in only three cases, or 10.3 percent.

These figures indicate that silver nitrate is most effective in gonorrheal ophthalmia

when painted on the conjunctiva, and in gonorrheal ophthalmia neonatorum when instilled in the conjunctival sac.

Four hospitals in other cities used silver-nitrate solution to paint the conjunctiva. Three other hospitals instilled it in the conjunctival sac.

Antiseptic instillations. Many different solutions have been instilled into the conjunctival sac for their bactericidal action in gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum. Duane[9] recommended argyrol and protargol in "strong solutions" frequently instilled, as substitutes for silver nitrate. He thought that protargol was the more bactericidal of the two and, in strong solution, more efficient than silver nitrate if used "often enough." Parsons said that argyrol, protargol, and other colloid preparations of silver must not be used instead of silver nitrate, but only as drops when the critical period had passed.

De Schweinitz used protargol 10 percent and argyrol 25 percent to instil freely in the conjunctival sac, every hour to every four hours, for their detergent qualities. He claimed that these solutions sank to the bottom of the cul-de-sac and floated the pus and mucus to the surface. It was his opinion that while argyrol might be used in the treatment of gonorrheal conjunctivitis, it should not be used to the exclusion of silver nitrate.

Gifford advocated mercurochrome 1 percent and metaphen 1:2,500 instilled three times a day for their bactericidal effect. He mentioned the abortive effects of applications of bluestone, and the value of 0.5-percent solution instilled twice a day.

Duke-Elder and Fuchs also mentioned the use of the copper-sulphate or bluestone pencil, or alum pencil, in the last stages of papillary hypertrophy.

McKee quoted McQuillan as getting good results from 2- to 5-percent mercurochrome instilled five or six times a day in gonorrheal ophthalmia.

Bellows,[12] in a study of 20 cases of gonorrheal ophthalmia neonatorum, concluded that silver-protein salts had no place in either the prophylaxis or the treatment. In his cases the instillation of a 1:1,500 solution of acriflavine shortened the period of morbidity more than did solutions of 1:2,500 metaphen, and 1:5,000 mercury oxycyanide.

Thygeson[13] experimented with therapeutic agents in ophthalmia neonatorum. Using one eye as a control, he failed to find that any of the usual antiseptics shortened the course of the disease.

In the Cincinnati cases, argyrol in strengths varying from 10 to 25 percent, was instilled three to six times daily in the case of 17 patients with gonorrheal ophthalmia admitted free from corneal complications. Corneal ulcer developed in 52.9 percent compared with the group average of 43.8 percent. During the same period argyrol in strengths of from 1 to 25 percent was instilled frequently into the eyes of 21 patients with gonorrheal ophthalmia neonatorum admitted without corneal involvement. Corneal ulcer developed in 16.6 percent compared with the group average of 14.7 percent.

Acriflavine in strengths varying from 1:500 to 1:1,500 was instilled into the eyes of 33 patients with gonorrheal ophthalmia admitted without corneal complications. Of these, 15, or 45.4 percent, developed corneal ulcer. The same strengths of acriflavine were instilled into the eyes of 44 patients with gonorrheal ophthalmia neonatorum admitted free from corneal damage. Corneal ulcers developed in 20.4 percent, against a group average of 14.7 percent. These figures indicate that acriflavine, as an instillation, was of little or no value in gonorrheal conjunctivitis.

Eight hospitals in other cities used instillations of argyrol in various strengths;

three used instillations of aqueous mercurochrome; one used protargol; none used acriflavine; one used optochin.

Since the gonococci penetrate the conjunctival epithelium and beneath it, antiseptic solutions would hardly be of much value aside from their use as irrigating fluids.

Ointments, instilled to prevent the lid margins from sticking together, have been advised by all writers on the subject. Boric-acid 5-percent ointment, merthiolate 1:5,000, mercuric chloride 1:5,000, and yellow oxide of mercury 1-percent ointments have been used.

Subconjunctival injections. Various solutions have been injected subconjunctivally in gonorrheal ophthalmia. De Schweinitz reported Hirsch to have used oxycyanide of mercury 1:5,000 to which acoin had been added, but expressed no opinion as to its value.

Parsons mentioned the subconjunctival injection of 1:5,000 mercury oxycyanide and 2- to 10-percent sodium chloride in the presence of rapidly progressive corneal ulcer. Cocainization before hand is necessary. Normal saline has been used in a similar manner. All are said to increase the local lymphatic activity.

Cowan[14] injected 15 minims of Pregl's solution under the highest point of edematous bulbar conjunctiva with holocaine anesthesia. This was repeated daily as long as the laboratory report remained positive for gonococci. Iced compresses, irrigations, atropine, silver nitrate 1 percent to the everted lids, and zinc sulphate 0.25-percent instillations in the third stage were used also. Pregl's solution is a complex hypoiodite preparation which liberates nascent iodine in contact with acid tissues. In the six cases so treated gonococci disappeared in an average of 6.5 days. Useful vision was lost in one eye whose cornea was opaque on admission.

Subconjunctival injections were not used in any of the Cincinnati cases.

Nonspecific or foreign-protein therapy has been widely used in the treatment of gonorrheal conjunctivitis for several years. Some investigators attribute the good results to the hyperpyrexia produced. Others believe that there is a stimulation of the body defenses, such as an increased formation of antibodies. Frequently dramatic improvement follows, with reduction in the lid swelling, conjunctival chemosis, and discharge. The gonococci in the epithelial scrapings become fewer in number.

Whole milk, freshly boiled for five minutes and injected intramuscularly, has found much favor, while typhoid vaccine and typhoid-H antigen have given good results also. Many proprietary foreign proteins have appeared on the market, such as lactogen, aolan, edwinal, and omnadin. They have not proved superior to the first three mentioned.

Duke-Elder stated that foreign-protein therapy was effective only in the early stages. Parsons was of a similar opinion. McKee used whole boiled milk, starting with an average infant dose of 1 c.c. and giving as much as 10 c.c. to adults. The febrile reaction was his guide. Gifford also favored whole milk freshly boiled. So effective did he find it that he considered its routine use the safest plan. Starting with 1 c.c. as an average dose in babies, he increased it gradually every third day to 3 c.c. in three or four doses.

Farrell[15] made a study of 189 cases of gonorrheal ophthalmia in patients over six months of age at the Massachusetts Eye and Ear Hospital from 1916 to 1931. The results in 15 cases treated with foreign proteins were not encouraging.

Bellows[12] considered foreign-protein therapy the second most important treatment measure in gonorrheal ophthalmia neonatorum.

Hamilton[16] used whole cow's milk

boiled four minutes and injected intramuscularly in the treatment of gonorrheal ophthalmia. He began with 10 c.c. and repeated the dose on alternate days, increasing rapidly to 25 c.c. He found the chief risk to be anaphylaxis, and recommended that adrenalin be on hand. Gluteal abscesses occurred but responded to orthodox treatment. He found milk injections to be contraindicated in weak and debilitated patients—especially in marasmic children, tuberculosis, renal disease, and in the last months of pregnancy.

Hektoen[17] stated that the therapeutic use of protein may give rise to more or less permanent sensitizations.

Geiger and Burlingame[18] used typhoid vaccine intravenously to produce hyperpyrexia in 68 of 140 patients with gonorrheal conjunctivitis. In 29 cases of gonorrheal ophthalmia neonatorum the average beginning dose was 10 million killed typhoid bacilli, given either in the external jugular vein or the superior longitudinal sinus through the anterior fontanelle. They doubled the dose each day for four days or longer, depending on the response. Each dose was preceded by adrenalin 2 minims administered intramuscularly. Local treatment was continued along with the typhoid vaccine. The incidence of corneal ulcer in these 68 cases was 13 percent, while in the control group, receiving only local treatment, corneal ulcers occurred in 27 percent.

Duke-Elder stated that specific vaccines and sera were useless, except in unusually prolonged and chronic cases.

Whole cow's milk, freshly boiled for five minutes, was injected intramuscularly in doses up to 10 c.c. every second or third day in 23 of the 105 patients with gonorrheal ophthalmia in the Cincinnati group admitted without corneal damage. Corneal ulcers occurred in 12, or 53.13 percent, compared with 43.8 percent in the whole group.

Sterile milk was given intramuscularly to 11 patients with gonorrheal ophthalmia neonatorum. The dosage began with 0.5 c.c. or 1 c.c., depending on the size and strength of the baby. It was repeated every second or third day for several doses and increased to a maximum of 3 c.c. No corneal ulcers developed. The average duration of hospitalization for this group was 31.2 days.

These figures indicate that boiled whole milk, injected intramuscularly as a foreign protein, was more effective in gonorrheal ophthalmia neonatorum than in gonorrheal ophthalmia.

Triple-typhoid vaccine was used intravenously in four patients with gonorrheal ophthalmia complicated by corneal ulcer or arthritis. Beginning with 25 million, the dose was doubled every other day as long as necessary, or up to a maximum of 1,600 or 2,000 million bacilli. When a febrile reaction was obtained, excellent results were noted.

Typhoid-H antigen was used in the treatment of three patients with gonorrheal ophthalmia in whom corneal ulcers had developed. The febrile and constitutional reactions were less than those induced by the triple-typhoid vaccine, yet the results were equally good.

Neither typhoid vaccine nor typhoid-H antigen was used in gonorrheal ophthalmia neonatorum.

Boiled milk was used as foreign-protein therapy in gonorrheal conjunctivitis by eight of the hospitals in other cities; typhoid vaccine by six hospitals; and typhoid-H antigen by two. One used aolan, one edwinal, and two diphtheria antitoxin. All claimed good results.

Gonococcal vaccine has been tried by a number of capable clinicians without success.

Sulfanilamide. Sulfanilamide, a benzene derivative, first used successfully in the treatment of streptococcal infections,

has been found of value in treating gonococcal infections. Following the initial wave of enthusiasm, there came reports of therapeutic accidents ascribed to the new drug; most of them mild but some fatal. Sulfanilamide[19] was found to be toxic in some degree in nearly all cases in which it was administered. Some persons[20] showed an idiosyncrasy to very small amounts of the drug.

Symptoms[21] of mild toxicity are malaise, weakness, lassitude, headache, dizziness, anorexia, and slight to moderate cyanosis and dyspnea. They need not cause alarm.

Moderately severe toxic symptoms are deep cyanosis, marked dyspnea, severe vomiting, diarrhea, abdominal pain, pruritus, and increasing anemia. They indicate reduction in dosage.

Fever, dermatitis, acute hemolytic anemia, leukopenia, psychosis, and jaundice indicate severe toxicity; the drug should be discontinued.

Deaths have resulted from acute hemolytic anemia[22] and granulocytopenia.[23]

Sulfanilamide is contraindicated in patients with anemia, leukopenia, or hepatic damage. It is excreted almost entirely from the kidneys.[24] Patients with renal insufficiency must be given smaller doses and watched carefully.[25] It was found necessary to keep a constant check on the blood sulfanilamide level, the blood leucocyte count, the erythrocyte count, and hemoglobin for danger signs.

The simultaneous administration of sulfanilamide and sulphates is contraindicated because of the possibility of causing sulphemoglobinemia.[21] Optic neuritis in a child after a 5-grain dose of sulfanilamide was reported by Bucy.[26] Symptomatic purpura haemorrhagica following the administration of sulfanilamide was reported by Markel and Rike.[27]

The mode of action of sulfanilamide has not been definitely determined. Nearly all investigators[28] have agreed that pathogenic organisms are impaired by sulfanilamide and made vulnerable for the defense powers of the body. Strains of sulfanilamide-fast gonococci have been found. These require a considerably stronger than usual concentration of the drug to inhibit their growth, both *in vitro* and *in vivo*.

Willis[29] expressed the opinion that a large initial dose of sulfanilamide, about 0.114 gm. per kilogram body weight, should be given in gonorrheal ophthalmia neonatorum. He followed this with a maintenance dose of 0.20 to 0.25 gm. per kilogram per day, in equally spaced doses, to get a blood sulfanilamide level of 7 mg. per 100 c.c. The infants received irrigations and cold compresses as local treatment.

There is general agreement among clinicians that the average optimum blood concentration of sulfanilamide is 3 to 10 mg. per 100 c.c. for all ages. Some resistant cases require a higher level.

Michels[30] treated gonorrheal ophthalmia in 15 children, aged from five days to three years, with sulfanilamide. The basic dose was one grain per pound body weight daily, with an equal amount of sodium bicarbonate. No complications attributable to sulfanilamide were observed. Two patients had corneal ulcers that did not perforate. The average duration of hospitalization was 5.8 days, against 28.5 days for a control group of 32 cases in which sulfanilamide was not administered. The only local treatment was frequent irrigation of the conjunctival sac.

Barbour and Towsley[31] treated 15 cases of gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum with sulfanilamide. The average blood concentration of sulfanilamide in their cases was 12.5 mg. percent. They found that newborn infants tolerated and required relatively large quantities of sulfanilamide. The

average daily dose for the first three days was 2.7 grains per pound for patients under one year of age, and 1.6 grains per pound for patients over one year. In only one case was the drug discontinued because of toxicity—a severe cyanosis. Corneal ulcer occurred in only one case, compared with its occurrence in five cases in the pre-sulfanilamide series. The average duration of the disease in the sulfanilamide group, after the start of treatment, was 8.3 days, compared with 30.7 days for the control group.

Rein and Tibbetts[32] used sulfanilamide 0.5-percent solution as a conjunctival irrigation every 15 minutes night and day in the treatment of 15 cases of gonorrheal conjunctivitis. When other gonorrheal infections were present, they gave sulfanilamide orally in addition. No other treatment was used. The average number of days before a negative smear was obtained was 6.8, compared with 27.2 days in a control series treated by earlier methods. Corneal ulcers healed without perforation.

Sysi[33] treated 11 cases of gonorrheal conjunctivitis with sulfapyridine in the large doses customary in lobar pneumonia, with good results. Two patients developed nausea and cyanosis, requiring discontinuance of the drug. Local treatment was given as well. Brown, Thornton, and Wilson[34] found serious toxic manifestations twice as frequently with sulfapyridine as with sulfanilamide in their two series of 100 cases each. Kattiofsky[35] found that local administration of sulfanilamide in an ointment gave no better results than did the customary therapy. Numerous clinicians have found that sulfanilamide must not be discontinued abruptly because of the likelihood of a relapse.

In the Cincinnati series sulfanilamide was used in six cases of gonorrheal ophthalmia, and in two cases of gonorrheal ophthalmia neonatorum. The results were not spectacular. Two adults developed dermatitis, and one infant had convulsive seizures, requiring discontinuance of the sulfanilamide. In one adult, the gonorrheal ophthalmia cleared up in about five days, but a complicating arthritis proved resistant. One adult was resistant to sulfanilamide, and lost his eye when panophthalmitis followed perforation of the cornea. The remaining two adults and one infant made quick recoveries. The usual local treatment was used along with the sulfanilamide.

Seven of the 12 hospitals in other cities reported that they were using sulfanilamide in the treatment of gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum, together with local measures. All considered sulfanilamide an important advance in treatment.

Considering the accumulated therapeutic evidence, one must conclude that sulfanilamide is of great value in the treatment of gonorrheal conjunctivitis. It must be handled with respect for the possible severe toxic upsets that may occur. Every precaution must be taken to guard against these undesirable disturbances. Close cooperation with the clinical laboratory must be maintained, and the possibility of idiosyncrasy always remembered.

Artificial hyperpyrexia. Like sulfanilamide, artificial hyperpyrexia is a relatively new weapon in the battle against the gonococcus.

Simpson,[36] who pioneered in artificial-fever therapy with the Kettering hypertherm, stated that the procedure should be restricted to institutions in which the physicians and nursing personnel had received adequate preliminary training. He thought that the immune reactions of the body were stimulated, in addition to the sterilizing effect on the disease germs.

Owens[37] found 12 percent of patients unsuitable because of contraindications. Such are[38] electrocardiographic evidence of myocardial damage, heart block,

chronic alcoholism, susceptibility to heat prostration, active pulmonary tuberculosis, vascular hypertension,[39] renal disease, and uncontrolled diabetes.

Warren, Scott, and Carpenter determined the thermal death time of the gonococci in each case. Taking 106.7°F. as the highest temperature the body can safely tolerate for periods of from 8 to 24 hours, they based the length of each treatment on the thermal death time of each patient's strain of gonococcus at this temperature. They found the thermal death time of the gonococcus to vary from 6 to 24 hours at 106.7°F. One death occurred in a series of 283 patients.

Ballenger, Elder, McDonald, and Coleman, Jr.,[40] found artificial-fever therapy of value in treating sulfanilamide-resistant gonorrhea.

Hasler and Spekter[41] reported an average length of hospitalization of 15.3 days for six patients with gonorrheal ophthalmia given artificial-fever therapy and local measures. They compared this figure with an average of 25.2 days for six patients given local treatment and typhoid vaccine. De Jardins, Stukler, and Popp[42] gave 76 patients 3 to 6 sessions of 6 to 10 hours at 106 to 107°F. and cured 69.5 percent of them.

Artificial-fever therapy as conducted in the Cincinnati General Hospital has been admirably described by McGavic.[39] Since his series of cases was reported, hyperpyrexia with the Kettering hypertherm has been reserved for the more desperate cases of gonorrheal ophthalmia. Excellent results were obtained. Eyes were saved when routine local measures, foreign proteins, and sulfanilamide appeared to be failing. The youngest patient treated was 1½ years of age. No fatalities occurred.

One hospital among those reporting from other cities used artificial hyperpyrexia in the treatment of gonorrheal ophthalmia. It was used in cases resistant to local therapy and other measures.

Corneal ulcer is probably the most feared complication of gonorrheal conjunctivitis. Because of this fear, many good clinicians advise and use atropine routinely in all cases, from the start until recovery is near. Other equally respected clinicians do not use atropine until the indication arises. If the corneas are carefully inspected daily, beginning corneal ulcer can be detected in ample time to get the pupils dilated with atropine.

In many cases of gonorrheal ophthalmia and gonorrheal ophthalmia neonatorum, the cause of corneal ulcer is faulty care on the part of the attendants. Rough and careless handling of the lids by attendants with long fingernails may bruise the cornea. Ulcers may develop after separation of eschars produced by silver nitrate. Delay by the patient, or his guardians, in seeking treatment is an important etiologic factor also. Parsons mentioned general malnutrition as a prominent cause of corneal ulcer.

As stated previously, the corneal epithelium is continually bathed in the mucopurulent discharge and becomes invaded by gonococci. It is more easily abraded than normal epithelium. The chemotic circumcorneal conjunctiva impairs corneal nutrition by pressure on the marginal vascular loops. When the chemotic bulbar conjunctiva overlaps the cornea, the underlying epithelium becomes macerated by the retained discharge, and ulcer occurs frequently in that location.

Insufficient irrigation, trauma, and poorly performed treatment, were most frequently assigned as causes of corneal ulcer by hospitals in other cities. One gave the "lytic action of pus" along with trauma as the cause of most ulcers.

Among the precautions taken by these hospitals to prevent corneal ulcers were: 1. Careful instruction of nurses about irrigation. 2. Avoidance of trauma. 3. Fre-

quent irrigations to keep the eye or eyes free from discharge. 4. The use of bulb-tipped glass droppers and blunt irrigating tips.

A great variety of treatments has been used for corneal ulcers occurring in gonorrheal eye disease. The presence of a conjunctival discharge precludes bandaging the eye as for simple uncomplicated ulcers. Most procedures are aimed at checking the corneal infection before perforation occurs.

Duane[9] sprinkled some ulcers with powdered iodoform daily. In other cases he used absolute alcohol or tincture of iodine applied to the ulcer with a fine cotton-wrapped applicator. When milder measures failed, he cauterized the ulcer with nitric or carbolic acids on a toothpick. As a still stronger procedure he applied the actual cautery with excellent results. In addition he did paracentesis of the cornea. This latter procedure was developed when corneal ulcers were noted to heal rapidly after perforation. The new-formed aqueous was considered to be richer in antibodies than the old.

In addition to measures mentioned by Duane, de Schweinitz advised curetting the ulcer base before using a chemical cauterant. Both de Schweinitz and Gifford[10] used trichloracetic acid 15 to 50 percent applied to the ulcer with a fine applicator. Duke-Elder[1] considered pure carbolic the best chemical cauterant. He used it following light curettage of the ulcer base. On severe ulcers he used the actual cautery.

When the ulcer appeared to be progressing in spite of treatment, paracentesis was advised by all authors to forestall perforation. Some covered the ulcer with a pursestring conjunctival flap. Usually the ulcer was healed when the suture cut out, 7 to 10 days later.

Among the Cincinnati cases, corneal ulcer occurred after admission in 46 out of 105 cases of gonorrheal ophthalmia, or 43.8 percent. Including ulcers present on admission, the total incidence was 56 out of 115 cases, or 48.69 percent. The colored patients received the same treatment as the whites, yet the incidence of corneal ulcer among them was 35.8 percent after admission, compared to 48.4 percent in whites.

Among cases of gonorrheal ophthalmia neonatorum in 122 patients admitted without corneal involvement, 18, or 14.7 percent, developed corneal ulcers. On the same treatment, corneal ulcers developed in 13.3 percent of the colored babies and in 15.5 percent of the white babies.

These figures indicate that babies of the white and colored races are about equally susceptible to corneal damage in gonorrheal conjunctivitis. On the other hand, colored adults seem to be less prone to corneal ulcers than are white adults.

Therapeutically, various chemical cauterants, such as trichloracetic acid 15 to 50 percent, tincture of iodine, syrup of iodine, and silver nitrate 5-percent solution, were used when the ulcer first appeared. Radial circumcorneal incisions were made with scissors in the chemotic bulbar conjunctiva. When the ulcer progressed in spite of these measures, it was sometimes covered with a purse-string conjunctival flap. At other times repeated paracenteses of the cornea, preceded by intravenous injection of typhoid-H antigen, as advocated by Brown,[43] were used successfully. Usually atropine was not instilled until the indication arose. The corneas were carefully inspected daily, Desmarre lid retractors being used when necessary. In some cases cod-liver-oil ointment 25 percent was instilled three times daily to stimulate epithelial proliferation. In only one case did there seem to be a pronounced vitamin deficiency.

Four of the hospitals in other cities used atropine routinely in all cases of gonorrheal conjunctivitis. Three waited for indication of corneal involvement before using atropine. One used subconjunctival Pregl's solution daily as long as the cornea stained, and applied chemical caustics to the ulcer. One used corneal paracentesis and a pressure bandage when the ulcer appeared dangerous. Three used a conjunctival flap, and one the actual cautery. Two used trichloracetic acid, and one tincture of iodine as caustics. One used zinc-sulphate solution 0.2 percent as an instillation. One used hot compresses along with foreign proteins.

Constitutional or general treatment. The general health of the patient must not be forgotten. The eye, as a part of the body, shares its weal and woe. Most of the patients with gonorrheal conjunctivitis come from the lower strata of society. Often they are undernourished, and sometimes debilitated by previous or coexistent disease. De Schweinitz[4] said it was a serious mistake, in the severe forms of the disease, to depend on local measures alone.

The coöperation of the pediatric department is important to keep the infants thriving. Local measures may accomplish little, and sulfanilamide may be dangerous in a feeble infant.

In adults a high-vitamin diet is indicated, with extra vitamins in the form of cod-liver oil. The use of tonics, and appropriate treatment of coexistent disease is mentioned by all authors.

Results of treatment. Of the 115 Cincinnati cases of gonorrheal ophthalmia, 56 were monocular and 59 binocular. The monocular cases consisted of 26 right eyes and 30 left eyes.

The average lengths of hospitalization for the years 1927, 1929, and 1937 were 40, 22, and 30 days, respectively.

Corneal ulcers developed in 56 cases of gonorrheal ophthalmia, or 48.69 percent. In 10 cases the ulcers were present on admission. Visual impairment in one or both eyes resulted in 30 cases, or 26.08 percent. Perforation of the cornea occurred in 19 cases, or 16.5 percent. There were 21 cases, or 18.2 percent with less than 20/100 vision in the involved eye or eyes. Of these 21 cases, 14 were in the group of 105 admitted without corneal damage. Thus delay in getting treatment resulted in great visual impairment in 7 cases out of 10, or 70 percent, contrasted with 13.3 percent in those arriving before involvement of the cornea.

In two cases, or 1.7 percent, vision was below 20/100 in both eyes. In the other 28 cases, there was 20/30 vision or better in the remaining eye. The corneal damage was largely confined to the right eye in 15 cases, and to the left in 13.

There were 99 binocular cases of gonorrheal ophthalmia neonatorum, and 27 monocular divided into 10 right eyes and 17 left eyes. The average lengths of hospitalization for the years 1927, 1929, and 1937 were 38, 61, and 24 days, respectively.

In the 126 cases corneal ulcer occurred in 22, or 17.46 percent. The incidence of corneal ulcer in the 122 patients admitted with undamaged corneas was 14.7 percent. Great visual impairment occurred in 12, or 9.5 percent, of the total series of 126, and in 9, or 7.3 percent, of the group numbering 122. In every patient the visual impairment amounted to loss of the eye or a large dense leukoma. Total loss of vision in both eyes occurred in 4, or 3.17 percent, of the whole series, and in 3, or 2.45 percent, of the 122-case group. In five cases the right eye was lost, and in three, the left.

Hospitals in other cities reported on a total of 307 cases of gonorrheal ophthalmia. Of these 233 were monocular and 74

binocular. The average lengths of hospitalization for 1927, 1929, and 1937 were 31, 18.6, and 17.3 days, respectively. Impaired vision in one or both eyes occurred in 91 cases, or 29.6 percent.

The 293 cases of gonorrheal ophthalmia neonatorum reported from outside hospitals were divided into 101 monocular and 192 binocular. The average lengths of hospitalization for the years 1927, 1929, and 1937, were 47, 29.6, and 22.9 days, respectively. Impaired vision in one or both eyes resulted in 33 cases, or in 11.2 percent.

Summary

Gonorrheal eye disease continues to exact a toll of damaged and lost eyes in spite of more efficient prevention and improved treatment.

Buller's shield, while still used on adults in most hospitals, has been discarded in some in favor of posture alone.

Irrigation of the conjunctival sac is considered to be indispensable by all clinicians. Iced compresses are most frequently used for lid swelling, while hot compresses are used occasionally for the same purpose.

In the Cincinnati cases intermittent iced compresses were found of benefit, while the use of continuous iced compresses increased the frequency of corneal ulcers.

Corneal ulcers occurred much less frequently in gonorrheal ophthalmia when the palpebral conjunctiva was painted with silver nitrate 0.5- to 2-percent solution by a physician, than when the same solution was instilled.

Fewer corneal ulcers occurred in gonorrheal ophthalmia neonatorum when silver nitrate 0.5- to 2-percent solution was instilled in the conjunctival sac than when it was painted on the palpebral conjunctiva.

Silver-protein solutions and other antiseptic solutions were found of no value apart from their use as irrigating fluids.

Freshly boiled whole cow's milk, injected intramuscularly, was found to be of more value in gonorrheal ophthalmia neonatorum than in gonorrheal ophthalmia. It was found to be the foreign protein most favored by ophthalmologists for use in this disease. Hektoen's objection to the use of milk injections, because of the possibility of causing sensitization, is not substantiated by a sufficient number of reports in the literature to be considered seriously.

Sulfanilamide therapy has proved to be a definite advance in the treatment of gonorrheal eye disease. Its value has been widely recognized and reported.

Artificial hyperpyrexia was found of value in the treatment of severe and resistant cases of gonorrheal ophthalmia.

Colored and white infants seemed about equally susceptible to corneal damage. Colored adults were less susceptible than white adults, although both were more susceptible to corneal ulcers than were the infants of their respective races.

The cornea should be inspected daily. Diligence and skill on the part of the doctor will save many eyes. When chemical and thermal cauterants appear to be unable to check a corneal ulcer, repeated paracenteses or a conjunctival flap should be used.

The general health of the patient must be maintained.

Conclusions

Progress in the treatment of gonorrheal eye disease may be said to have made three considerable advances in the last decade. In the order of their introduction, credit for these advances must be given to: 1. Nonspecific or foreign-protein therapy. 2. Artificial-fever therapy. 3. Sulfanilamide therapy. The second is closely allied to the first in its rationale. The third achieves its results in an entirely different

manner and is a form of chemotherapy. In none of them is the mode of action entirely understood, and their use is fundamentally empirical. All three have reduced the length of hospitalization; all have diminished the frequency and severity of corneal complications.

While sulfanilamide has produced more brilliant results than any previous therapeutic measure, it must be used with caution and a full understanding of its potential dangers. There will continue to be cases of gonorrheal conjunctivitis, resistant to sulfanilamide, in which recourse to all available therapeutic resources will be necessary to prevent loss of the eyes.

The methods and procedure used by the old masters of ophthalmology must not be discarded. When properly and skillfully used, they will continue to be found of value in many cases of gonorrheal eye disease.

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TRANSITORY MYOPIA*

A COMPLICATION OF SULFANILAMIDE THERAPY

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With the advent of the universal use of sulfanilamide preparations for many and varied diseases, the importance and recognition of its toxic effects has come to the front in controlling its administration. The various symptoms and findings resulting from the toxic action of sulfanilamide preparations have been thoroughly discussed by Perrin Long *et al.*[1] Toxic effects on the eye have been published in only a few instances. Bucy[2] reports a case of bilateral optic neuritis, due to sulfanilamide therapy, with a very rapid recovery. Colebrook and Purdie[3] mention a temporary "dimness of vision" from the toxic effect of sulfanilamide preparations, but do not describe the character of this ocular disturbance. Peripheral neuritis, however, has been more commonly found as a complication by Bannick, Brown, and Foster,[4] and indicates the vulnerability of the peripheral nerves. Mattsson,[5] of Helsingfors, recently described three cases of transitory myopia following sulfanilamide therapy, of which he observed one personally. Apparently Berns[6] was the first to publish a case of transitory myopia in a woman treated with sulfanilamide for a cystitis which was also associated with an exanthem. Spellberg,[7] Gailey,[8] and Missoroli[9] have recently published brief case reports of transitory myopia following use of sulfanilamide and its derivatives. More cases will undoubtedly be seen, and its existence and significance should be appreciated.

CASE REPORT

B. M., a white male, aged 34 years, was referred on September 6, 1939, by his family physician because of blurring of vision of 19 hours' duration. His family physician had been treating him with sulfanilamide for a gonorrheal urethritis during the past 14 days. He was taking 40 grains daily in 4 equally divided doses with an equal amount of sodium bicarbonate. The response to therapy was quite good. Repeated Wassermann examinations were negative.

On September 5, 1939, suddenly, at about 7:30 p.m. there was marked blurring of vision for distance, to such a degree that he was unable to drive his car. At no time had he worn glasses and he had never had any previous eye complaints. His vision, he believed, had been good in each eye. At the time he presented himself, he stated that his vision was as blurred as at the onset. The past history revealed no significant information.

The examination revealed a well-developed white male who did not appear to be acutely ill but whose temperature was 101 degrees and who had a pulse rate of 98. Unaided vision was 0.1 in the right eye and 20/300 in the left. There was good light perception and projection and a pin-hole improved the vision in each eye to 20/25. This immediately indicated a marked change in refraction as the cause of the blurring. The external ocular examination revealed normal lids, unrestricted extraocular movements, and good convergence. The cornea was clear, and irides were hazel. The pupil of the right eye was 4.0 mm. in size, slightly irregular,

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and smaller than that of the left. The reactions of each to direct light was normal, as was the consensual reaction and the reaction to accommodation.

A manifest refraction improved his vision to 20/20 in each eye. The lens necessary was a —1.50 D. sph. ⌯ —0.50 D. cyl. ax. 100° for the right eye and a —1.25 D. sph. ⌯ —0.50 D. cyl. ax. 180° for the left. With this correction he had 5.5 diopters of accommodation in the right eye and 5.25 diopters in the left.

One hour after homatropine 5 percent and paredrine 1 percent had been instilled, a retinoscopy confirmed the findings of the manifest refraction. The residual accommodation in each eye was 2.0 diopters. The pupils dilated equally to 7.5 mm. The media were clear and the tactile tension was normal. The optic disc, the macula, and the periphery of the retina were normal in all respects. There was no evidence of hemorrhages nor of exudates even in the far periphery. A slitlamp examination revealed no evidence of any inflammatory process in the anterior segment of the eye. The lens showed no evident pathological abnormalities. The sulfanilamide was stopped immediately and the patient was advised to imbibe a considerable amount of fluid. No miotics were prescribed.

In the next 24 hours he developed a toxic dermatitis characteristic of that seen following sulfanilamide therapy. Within 48 hours his vision became entirely normal in each eye. On September 12, 1939, the unaided vision in each eye was 1.2, and the accommodative power in each eye was 6.0 diopters. On September 20, 1939, another cycloplegic refraction was completed and this time the refractive error in the right eye was corrected with a +0.75 D. sph. ⌯ +0.50 D. cyl. ax. 175° and in the left eye with a +1.00 D. sph. ⌯ + 0.5 D. cyl. ax. 90° lens. On September 23, 1939, the accommodative power with the full correction in each eye was 6.5 diopters. The patient stated that he was perfectly comfortable and his distance vision unaided was as good as previous to the disturbance.

Discussion

Perrin Long[1] states that fever is an important warning sign in controlling the administration of sulfanilamide. The onset of blurring of distance vision can be considered another warning signal. This case illustrates the presence of both of these signs. The fact that so few cases of transitory myopia have been reported does not signify that it is rare, but more likely that the drug is often administered to acutely ill patients in whom this symptom can be easily overlooked. Another fact is that if this myopic change occurs in a rather hyperopic eye no change in distance vision would occur because the eye would only become less hyperopic and not myopic, and thus produce no visual symptoms.

It is a well-known fact that in iritis and direct trauma a temporary myopia may occur. In iritis, the inflammatory products increase the index of refraction of the aqueous, or the edema of the ciliary body may produce a spasm of the ciliary muscle, thus leading to a thickening of the lens. Atropine should, however, relieve the latter. It is conceivable that an edema of the ciliary body might by displacement relax the zonule and thus produce a thickening of the lens.

In trauma a variety of causes might lead to the production of a transitory myopia. A common variety is a perforating injury of the cornea with loss of aqueous, leading to a moving forward of the iris-lens diaphragm and thus producing a myopia.

Transitory myopia in diabetes has also been described frequently in ophthalmologic literature and thoroughly reviewed by Duke-Elder,[10] Berke,[11] Granström,[12] and Rones.[13] There is no doubt that the disturbance must be in the lens, because in cases of unilateral aphakia transitory

changes have been noted only in the normal eye. It cannot be due to the blood-sugar content of the lens, because in order to have an increase in refractivity it would take a concentration of 5 percent, whereas it is rarely over 1 percent (Rones[13]). Krause[14] believes that the refractive changes occur in the lens and explains it as a disturbance of the acid-base equilibrium. If the pH is lowered in the blood by carbonic and other acids, which can diffuse through the capsule and cells of the lens, the osmotically active ions of the lens are increased. The lens swells and increases its refractive power, thus producing a decrease of the hyperopia or an increase in the myopia. The lenticular protein becomes osmotically less active through replacement of the active carbonate ions; therefore, acidification with carbonic and other diffusible acids leads to swelling of the lens and dilution of its total base content. Alkalinization has the reverse effect and produces a hyperopia.

Duke-Elder[10] has shown that with a hyperglycemia, the sodium-chloride content of blood drops. Therefore, the salt content is also lowered in all bodily tissues and likewise in the aqueous humor. The lens with sluggish metabolism resists it at first, but suddenly water enters the lens, and induces it to swell, thus increasing its refractivity. With a drop in blood sugar the reverse occurs. Hyperopia develops because water escapes from the lens into the surrounding fluid, which has a relatively low osmotic pressure. This theory, however, does not explain why in some cases marked changes in blood occur without any refractive changes. Granström[12] states that in the marked dehydration that is present in acute stages of diabetes, a dry retention of salt occurs in all tissues of the body. Similarly this also must occur in the lens, especially in its nucleus, thus raising the index of refraction, producing a myopia. Following therapy for the diabetes, the retained salt induces a temporary retention of fluid in the tissues. This retention of fluid in the lens produces a decrease in refractivity and thus a hyperopia. It seems that in both Duke-Elder's[10] and Granström's[12] theories these refractive changes are more directly concerned with distribution of salt rather than with the sugar metabolism.

Transitory myopia has been described in some cases of diarrhea associated with severe dehydration by Schieck,[15] Terrien,[16] and Schläpfer.[17] The disturbance in water and salt equilibrium in these cases might easily explain the myopia. The transitory myopia described by Milian,[18] and by Redslob and Levy[19] that follows an injection of arsphenamine preparations used in luetic therapy, is explained by these authors as due to an accommodative spasm. In many of the aforementioned diarrhea cases, atropine had been used but did not affect the myopia; nor does it affect the transitory myopia in cases of diabetes.

Miscellaneous disturbances have been found occasionally to produce a transitory myopia such as icterus (Moauro[20]), influenza (Lundsgaard,[21] Kadyi[22]), severe emaciation in tuberculosis (Gallus[23]), and the alkalosis from a Sippy diet in peptic ulcers (Thorson[24]). It has been seen during an acute onset of nephritis (Lindhal[25]).

Accommodative spasm can be ruled out in the case here reported because not only was the sphincter of the iris not involved but there was no headache, no nausea, nor vomiting, as is seen in association with an acute accommodative spasm. Homatropine dilated the pupil and did not affect the myopia. Atropine was not used. The fact that when the myopia was present the amount of accommodative amplitude was only at the lower limits of normal and could be obliterated with homatropine also indicates that the accommodative mechanism was not involved. Homatropine reduced the accommodative power to a level

that we find in the average case of a cycloplegic refraction; namely, about 2 diopters. The case of Mattsson[5] corroborates these findings. Missoroli,[9] however, reports one case in which homatropine did not reduce the myopia but atropine did. This would lead to the assumption that his case had been due to a ciliary spasm.

In the case here presented, the amplitude of accommodation at the time of the blurring of vision was 5.5 diopters in each eye. After recovery it was 6.5 diopters in each eye. This amount of accommodation is within the normal limits for a man of his age (Duane[26]). The amount of myopia that developed was 2.25 diopters in the right eye and 2.5 diopters in the left. This indicates that the transitory myopia affected the accommodation only by depressing the total amplitude by approximately one half the amount of myopia that was induced. Therefore, no correlation can be made between the amount of myopia that developed with the difference in accommodative amplitude that was present before and after the transitory refractive changes.

The myopia reported in one case (Mattsson[5]) plus the accommodative amplitude present at the time with the full correction on was many diopters in excess of the total accommodation available in the patient at his particular age. This further fact rules out disturbances of the accommodation either of neural origin or of local pathological changes such as edema of the ciliary body. Therefore, we must look for disturbances in the lens itself as a source of the myopia.

In this respect two explanations might apply here. The first is concerned with the fact that allergic manifestations do occur from sulfanilamide administration, such as edema of the lids, and lips, and a generalized urticaria (Bannick *et al*,[27] Salvin[28]), and might conceivably produce an edema of the ciliary body, thus leading to an increased curvature of the lens surfaces. However, it is not unlikely that the lens itself might react to the allergin in such a manner as to increase the index of refraction and produce a myopia. All of the other tissues of the eye have been shown to be affected by an allergic reaction, and there is no reason why the lens should not also react similarly. In one case reported by Mattsson,[5] a very small dose of sulfanilamide precipitated the myopia, but it was given approximately 10 days after a previous course of sulfanilamide had been stopped.

The other mechanism that can be suggested for the myopia concerns the work of Bellows and Chinn[29] who have shown that the distribution of sulfanilamide in the eye is such that the concentration, with the exception of the vitreous, is lowest in the lens, but retains it long after it disappears from the aqueous and other tissues. This might lead to a difference in concentration of the drug in the lens as compared to the aqueous, thus disturbing the osmotic tension between the two. This, in turn, would produce an imbibition of water in the lens and thus an increase in its refractivity.

Therefore, from the cases that have been reported, it is entirely possible that the production of a temporary myopia from sulfanilamide therapy might be caused by any of the above cases; namely, a ciliary spasm, an allergic reaction of the lens or ciliary body, or from an osmotic change produced by the unequal distribution of the drug in the various tissues of the eye.

Summary

1. Transitory myopia occurs largely from the local ocular disturbances such as trauma and iritis and from general systemic diseases such as diabetes.

2. Drug therapy is an important etiological factor in its production, especially

from arsphenamine preparations and sulfanilamide.

3. The importance of sulfanilamide is attested by the fact that it is now in general use. The method by which it causes myopia is not entirely known. The case here reported would rule out ciliary spasm as a factor and would lead to the conclusion that it is more likely a reaction on the part of the lens either on an allergy basis or as due to a difference in the osmotic tension of the lens as compared to the aqueous produced by the unequal distribution of sulfanilamide within the eye.

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KERATOCONJUNCTIVAL LESIONS OBSERVED AT HIGH ALTITUDES IN BOLIVIA*

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I have been studying the ocular disease that is the basis of this study since 1914. The first case was observed in the city of Sucre. The disease is found only at high altitudes in Bolivia, at from 2,500 to 4,000 meters above sea level at which latter height lies the city of Potosí. This is the highest Bolivian city in which I have practiced. It should also be noted that the incidence of the disease parallels the altitude, as will be seen from the statistics. Before entering into the study of lesions observed, it is necessary briefly to describe certain climatic conditions of the country, in order that the best explanation of certain points of view on the etiology may be grasped.

Bolivia, situated in the center of South America, is a country of varied topography, a large part of which lies within the Andean chain, stretching to the east of the continent in low regions. The west, a zone of high and mountainous regions, is a mesa or high plain that reaches an elevation of 3,800 meters. On it are found important towns such as La Paz, the largest of all, Oruro, Uyuni, and others, and in the mountains Potosí and numerous mining towns. In the mountains, but at a lower altitude, are other cities, such as Cochabamba (at 2,565 m.), Sucre (about 2,824 m.), and Tarija (1,905) m.). Finally there are the low regions, the plains, at altitudes not greater than 500 or 600 meters.

The high plain, arid and dry, with crops of grains as the only vegetation, is cold. The mountainous region between it and the eastern low zones is temperate but also dry, except in the rainy season. The eastern plains, on the other hand, are humid and hot with a subtropical and even a wholly tropical temperature.

The high plain is humid only in the rainy season, which lasts from December to March or April. There are frequent snows, abundant rains, and electrical storms that ozonize the atmosphere; but there are also many days, or at least several hours, of bright sunlight. Autumn, winter, and part of spring are very dry, and the hygrometric saturation reaches its minimum. The majority of the days have plenty of sun. The dryness of the air makes the atmosphere very luminous; possibly there is an excess of actinic rays.

In general, the mountainous regions are temperate. Some, the highest, are cold in winter; others, more temperate in this season. The humidity is appreciable only in the rainy season, which has analogous characteristics and lasts for the same period of time as in the high plains. For eight months or a little more of the rest of the year the atmosphere is dry, although not so dry as in the areas bordering on the small streams and rivers, where there is more or less natural and luxuriant vegetation. The sky is most limpid, and in the long dry period there is a radiant sun, seeming to indicate that the atmosphere contains a great quantity of ultraviolet rays. In the rainy season frequent electrical storms ozonize the air.

The region of the low plains is generally humid, with exuberant vegetation. The atmosphere is less clear, the rains last a long time, and there are consequently many cloudy days. In reality winter does not exist there.

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* Read before the Pan-American Congress on Ophthalmology at Cleveland, Ohio, in October, 1940.

I have taken the name of the disease to be described from the period in which I observed the first case, *exuberant perikeratoconjunctivitis,* which gives an idea of the aspect of the lesions. It should be remembered that some authors (Carmony and Valle) employ this name, seldom used by the rest, to designate the affliction commonly called spring catarrh.

Clinical description

The patients, generally boys, come for consultation because they have red eyes and often a sensation of heat and again of itching. The attention of the parents is called to the chronicity of this condition, which without interruption or remission continues not only for months but for years.

The majority of cases that I have observed have been in boys under 15 years of age, in such proportion that in the 79 cases under my personal observation, 57 patients range in age up to 15 years inclusive, and 22 above this age. The youngest is a boy of 3 years, and the oldest 37 years old.

Age classification

Years	*No. of Cases*
Up to 3	1
4 to 7	15
8 to 10	21
11 to 15	20
16 to 20	13
21 to 25	5
Over 25	4
Total	79

As to sex, of the 79 patients, 55 were males and 24 females, the former being in the majority by more than two thirds.

According to locality the patients were divided as follows:

	Cases
La Paz	24
Cochabamba	12
Potosí	11
Oruro	10
Sucre	8
Uyuni	2
Tupiza	2

All of the rest were from villages or places in the country at an altitude of not less than 2,500 meters, while the majority came from altitudes of more than 3,500 meters. I must also point out that all were native Bolivians, and as regards ethnic characteristics some were whites, most half-breeds, and a few natives; there were no foreigners among them.

I shall describe first what the examiner encounters in cases that have continued over a period of several years. The patient has reddened eyes and a certain reflex contraction of the palpebral fissure. In fact, without there actually being photophobia, it is possible that unconsciously the patients constrict their palpebral fissures because of the glare.

Upon closer examination it is observed that the hyperemia of the eyeball is predominantly at the border of the cornea, now surrounding it completely, now double semilunar in configuration, the central part extending to the ends of the horizontal diameter. This hyperemia is at times light red in color, or more or less livid or violet colored. In some instances it is made up of fine blood vessels, in others of somewhat thicker, lightly flexible anastomoses, at an appreciable depth, some reaching the episclera.

But what principally characterizes the disease is the juxtalimbal neoformations. These are easily observable, since they form prominences that rise above the surface of the eyeball. Of a grayish-white color, with a gelatinous aspect similar to that found in vernal conjunctivitis, seemingly semitransparent, they surround the cornea, penetrating even to the substantia propria. In size they are usually 1, 1½, and even 2 mm., and comprise a circle or ring. This may be complete in exceptional cases and extend to the superior and inferior extremities of the vertical diameter, where, in the majority of cases, they disappear. These growths

are irregular in form, constituting a festooned line at the corneal limbus. The surface of the neoformations is irregular, with prominences that alternate with shallow depressions (fig. 1). It is to be noted

Fig. 1 (Solares). Showing the irregular outline of the new growths at the corneal limbus.

that on the corneal side the new growths end almost abruptly, although not sharply delimited; on the bulbar conjunctival side, however, with which the neoformation is in imperceptible continuity, the slope is gradual (fig. 2).

In some instances, portions of aberrant new growth are found somewhat sepa-

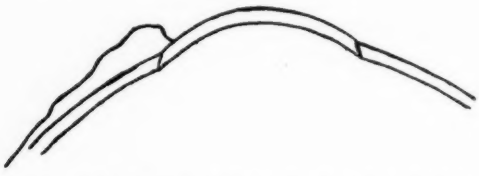

Fig. 2 (Solares). Schematic drawing depicting the position and configuration of the corneal new growth.

rated from the principal or juxtalimbal lesion, like little islands near the latter, although not completely separated from it, and extending into the bulbar conjunctiva. At times these prolongations have the aspect of a false pterygium (fig. 5).

The coloration is not always grayish white; quite frequently darker zones, greenish or sometimes chocolate colored, are to be seen. At times portions of the lesion have a dirty salmon color. The dark coloration may be uniform, or have zones that alternate with others that are clearer, paler, or even colorless.

The gelatinous aspect of the new growth is only apparent. It is, on the contrary, firm in consistency, lardaceous, or even cartilaginous, adhering as much to the cornea as to the adjacent episclera. In the bulbar zone and where the new growth is less dense, its adherence to the subjacent surface is slight, although the tissue does not have the looseness of normal conjunctiva. In some cases in which I have had to operate because of the amount of new growth, the resistance of the tissue to the edge of the knife has been surprising, it being necessary to proceed to a

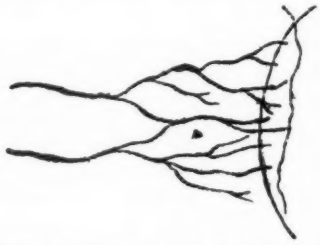

Fig. 3 (Solares). Origin and disposition of the blood vessels in the new growth, coursing horizontally to the periphery of the globe.

decortication, always delicate because of this close adherence. The fragility of the adjacent tissue often leads to laceration between the teeth of the forceps. Frequently there are small blood vessels that persistently bleed during the dissection, thus hindering the operation.

I have observed the existence of a vascularization in which the trunks constituting it are sometimes confluent with others, leading to the periphery of the eyeball, or rather to the equator, and terminate in two or three small but more voluminous, flexible trunks, which habitually course in the direction of the angles of the eye, situated at various depths in the substance of the conjunctiva. It is only exceptionally that these vessels run up or down. This disposition of the blood vessels brings about in some cases small pencillike vascular formations, more or less wide at the base near the limbus, thence running to the periphery of the bulbus (fig. 3).

The mucosa apart from the affected zone offers nothing in particular, since the inclusive hyperemia is regularly localized and always extends more horizontally than vertically.

In some cases in which the new growth does not constitute a complete circle, there are in the superior and inferior portions of the limbus very small rounded grayish prominences that scarcely measure one-fourth millimeter in size, forming a lineal curve above a hyperemic zone; they do not resemble in any case the so-called "points of Horner-Trantas."

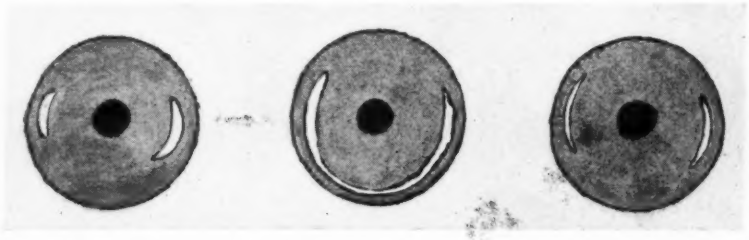

Fig. 4 (Solares). Corneal opacities, residual after the retrogression of the new growths; their various formations and disposition.

In the majority of cases there is no secretion. In some, a mucopurulent secretion usually scant, was observed, which in reality was due to secondary infection.

Usually there is nothing in particular in the rest of the bulbar conjunctiva, in the cul-de-sacs, or in the tarsus, except in those cases classified as *forma mixta*. The color or aspect of this form is milky white, bluish white, opalescent, and so on, which the majority of ophthalmologists point out as a concomitant change in the bulbar forms of vernal conjunctivitis.

The mixed form consists of changes in the fornix and tarsal conjunctiva as well. Here the only additional changes are a moderate hyperemia accompanied by a roughened aspect due to very small reddish prominences, so small that they barely succeed in effecting the velvety aspect that is analogous with that seen in cases suspected of presenting trachoma in its initial stage. I have never observed this change to increase nor to proceed to form the vegetations or prominences of the regularly smooth surface and the contours that because of reciprocal pressure begin to take on the polyhedral-pavement forms so typical of vernal conjunctivitis.

Here should be pointed out an appearance that I have noted in older cases or in those that are already proceeding to involution; namely, pearly white peripheral opacities of the cornea. There is no ulcer. The opacity is quite dense, a deep infiltration whose aspect has the brilliant white reflection of nacre or burnished silver. Its limits are clearly defined, and the color is uniform throughout the lesion. In the majority of cases it is found in the internal and external parts of the horizontal diameter, there being almost always two of these infiltrations, rarely but one. They may be totally isolated or take the form of slender bands or of a peripheral curved line that gives the appearance of a thin gerontoxon. Whatever may be the form of the infiltration, it is found separated from the limbus by a thin, clear corneal border. No new-formed vessel reaches them. Apart from the internal and external situations of these semilunar infiltrations I have never seen them in the upper or lower portion of the cornea except as the slender line previously mentioned. It is curious to note the concomitance between

the greater amplitude of the semilunar infiltrations and its preëminent location that corresponds to the perilimbal zones in which the new growths of the eyeball attain greater thickness and length (fig. 4).

Only the incipient cases reveal a slight pericorneal hyperemia that is exaggerated by some external irritating influence (heat, vapors, cold, rubbing the eyes). Aside from this there is nothing but a subjective symptom; the spontaneous, persistent itching that in some patients increases when the temperature becomes higher.

In the course of several months the pericorneal conjunctiva increases in bulk and finally forms the growths described.

Visual acuity is not compromised save in those cases in which an anomaly of concomitant refraction reduces it. In my opinion, astigmatism has no etiogenic influence on the affection.

In the final stages the new formations diminish little by little in volume, and the evolution of the dark colorations is observed. Occasionally throughout several years of this evolution the new formations are reduced in volume and remain stationary for an undetermined period of time. Through diverse circumstances I have not been able to follow the majority of the cases observed so as to say definitely how they turn out. On other occasions the retrogression, although so slow, can go so far that it seems complete. The lesions usually disappear without leaving any other trace than a certain persistent state of circumcorneal hyperemia, semilunar infiltrations, or a silver or pearly ring that is indelible, as I have indicated.

The general condition of the majority of patients is not the most satisfactory. Apart from the significance that the polyadenopathies, the hypertrophied tonsils, and adenoid vegetations have, the majority of the boys are poorly or deficiently nourished.

Fig. 5 (Solares). Appearance of the eyes in exuberant keratoconjunctivitis.

There is nothing in particular that points to hereditary influence. Neither can the disease be attributed to contagion, nor to any familial influence.

Concomitant affections, complications, evolution

In no case have I encountered preauricular adenopathy; on the contrary, in several cases there have been adenopathies of the neck, but I do not concede to these any importance as a causal factor in the affection, although the boys in whom cervical adenopathy without ocular lesions is found are numerous; besides, apart from its frequency, its significance as a transmitted effect of a tuberculous primary infection is well known.

Perhaps other affections are more important. Hypertrophied tonsils and adenoids and chronic hypertrophic rhinitis are found with relative frequency; yet a truly causal influence cannot be attributed

to them, for they are not evident in all cases of this ocular affection. In addition they are often observed unassociated with the ocular lesions. At most these may have a predisposing influence, perhaps allergic, that makes the rhythm of the metabolism change or creates an especial predisposition.

The only complication that I have encountered is keratoconus, observed in two patients. One of them (case 2568) was a girl 15 years old, in whom the right eye only was affected. The other (case 8935) was a subject whom I saw for the first time when he was 10 years old. There was no keratoconus. He was lost sight of for seven years. By that time the new growths had disappeared entirely, but on the other hand there was a bilateral keratoconus.

I insist on the fact that aside from the slight deterioration during the months of highest temperature, no other modification is produced throughout the rest of the year, and that the winter brings neither an objective nor a subjective remission. Patients whom I have attended in regions where the winter is severest—Potosí, Oruro, La Paz, Uncia, Uyuni—have not without exception presented an appreciable retrogression or attenuation of the new growths. The persistence of these in cold zones during three fourths of the year, and scarcely tempered during the other fourth, is an outstanding feature of the disease.

Finally, after a period of time often coinciding with puberty or adolescence, the picture begins to be modified until it completely disappears; or, at least, the lesions very appreciably diminish. The juxtalimbal new growths decrease in volume, leaving in their place a slight hyperemic growth that distorts the cornea and that finally disappears in the majority of cases without leaving a scar. Thus, as seasonal remissions do not occur, neither are relapses observed once the affection has disappeared.

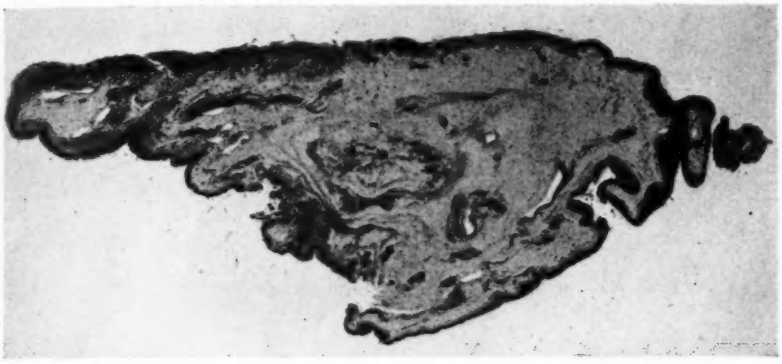

Fig. 6 (Solares). Photomicrograph of biopsy specimen, showing moderate changes.

Pathologic anatomy

Biopsy material was sent for examination to Dr. Julio Cesar Lascano Gonzalez, Chief of the Laboratory of Pathological Anatomy of the Faculty of Medicine of Buenos Aires, to whom I herewith express my great appreciation for the following report: "Three different specimens have been examined. They show distinct stages of the same lesion. The normal histologic constituents of the conjunctiva are observable in all of them. That is to say, a stratified epithelial pavement lying

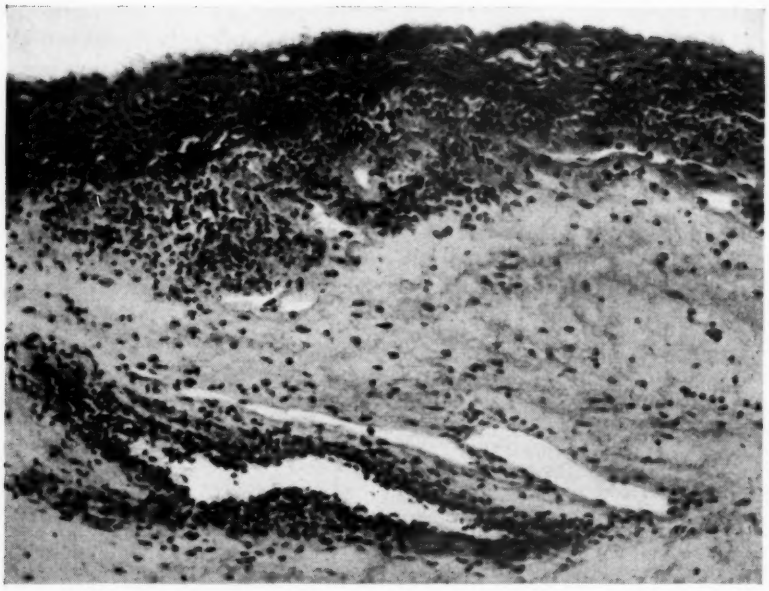

Fig. 7 (Solares). Same specimen as in figure 6 under higher magnification.

over a loose connective tissue.

"In one of the fragments (illustrated in figure 6) the only abnormal features are a slight puffiness of the conjunctiva, small thin columns of perivascular cellular exudation, and similar subepithelial infiltrations. (These characteristics can be better observed in figure 7, made with a higher power of magnification.)

"In another specimen (fig. 8) the lesion has the same structural characteristics but is much more extensive. All of the connective tissue, and I include zones of epithelium, is the seat of a massive infiltration of the same cellular elements that were found in the former.

"The characteristics of this infiltration common to all the parts analyzed are those

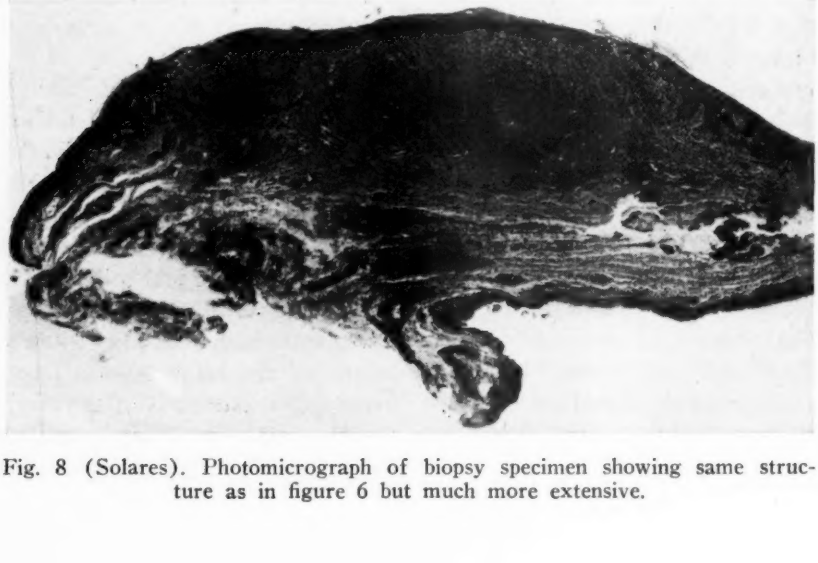

Fig. 8 (Solares). Photomicrograph of biopsy specimen showing same structure as in figure 6 but much more extensive.

of an inflammatory granuloma rich in predominantly mononuclear cells and with regular conjunctival proliferation. The cellular elements of the infiltration are either lymphocytes, plasmocytes, or histiocytes in different stages of evolution up to the fibroblast or the angioblast. The polynuclear cells are sparse and among the few that were found eosinophiles predominated. (Figure 9 shows the typical features of this granuloma.)

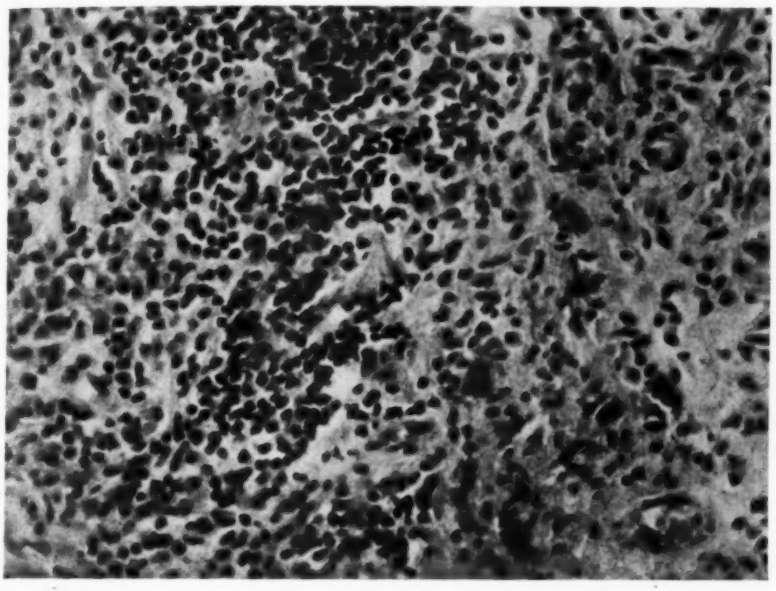

Fig. 9 (Solares). Photomicrograph of biopsy specimen showing the typical features of the granuloma.

"In conclusion, the lesion is one of inflammatory granuloma of slow growth, scattered in the conjunctiva, whose etiology it is difficult to determine. It has been impossible to stain these excrescences. We can hypothetically admit that they may be the result of an allergic reaction to an unknown agent, possibly an irritant substance suspended in the air. This supposition is made because of the morphologic characteristics of the granuloma, the eosinophiles and edema of which are usually encountered in inflammatory reactions in allergy."

Argañaraz, of Buenos Aires, speaks of a hypertrophy of the conjunctival epithelium that reaches three to four times its normal thickness. He points out a "notable hypertrophy of the conjunctival tissue" that due to its exaggerated development, involves the epithelium, forming the projections that characterize the affection.

Poulard points out the "proliferation of the conjunctival tissue and the cellular infiltration." Genet alludes to the "coagulation of the epithelial layer by multiplication of the cells," to the "chronic inflammatory process of the subepithelial tissue, with plasma cells, growth of eosinophiles, coagulation of blood vessels, connective tissue," and so on, finally, rudimentary infiltrations around the capillaries.

Gabriélidès indicates the "proliferation of cellular and fibrous elements of the subepithelial conjunctival tissue, of the conjunctival fibers of the tarsus" and the proliferation of the epithelium, which is "a secondary, inconstant condition," the

epithelial layer being at times thinned out, or, on the contrary, forming invaginations or also "deep proliferations." And he adds: "The vernal proliferation is found to consist of varieties of the following distinct cells: epithelial cells, cells of the conjunctival tissue, embryonal cells, or cells of adenoid tissue, leucocytes, plasma cells, and blood vessels."

There is nothing that may be specific or characteristic in the pathologic description of vernal catarrh. On the contrary, these are the various common characteristics to be found in other conjunctival affections accompanied by proliferation, such as follicular conjunctivitis, Perinaud's conjunctivitis (the so-called conjunctivitis of animal origin), and even trachoma.

Statistical data

In regard to vernal catarrh, ophthalmologists agree as to its characteristic frequency. The "French encyclopedia of ophthalmology" notes the following figures:

	Cases	*Ocular Patients*
Danvers, Parma	50	22,398
Schoebl, Prague	23	20,000
Schiess-Gemusens, Basel	14	28,338
Knuss, Zürich	64	33,609
Emmert, Bern	48	12,486
Kubli, Petrograd	2	20,690

Statistics of the Ophthalmological Clinic of the Faculty of Buenos Aires give (1905) a proportion of 70 percent, and for the years 1906 to 1909, a percentage of 21.

Gabriélidès, in the book already cited, gives the following extreme figures for comparison: the highest percentages are those of Gonin and Cuénod in Lausanne and Tunis, respectively, 173 cases in 43,000, and 20 in 3,000. And as a minimum, we have those of Natanson in Petrograd with a single case in 191,000, and those of Kravkov in Moscow with 3 cases in 100,000. The personal statistics of Gabriélidès in Turkey give in five years (1915 to 1919, inclusive) 85 cases from a total of 10,682.

My personal statistics to the time of this writing (September, 1940) include 79 cases of what I call exuberant perikeratoconjunctivitis from a total of 13,150 ocular patients, observations gathered in various regions of Bolivia. In lower localities like Tarija (1,905 m.) and Santa Cruz (around 600 m.) no case of the exuberant type was found. On the other hand in Sucre I had two cases of vernal catarrh originating in the aforementioned districts of Santa Cruz.

Discussion

I believe that the inherent characteristics of the cases would permit recognizing them as peculiar features constituting a separate disease entity. Because of the etiologic, clinical, and evolutionary peculiarities I have designated it "exuberant perikeratoconjunctivitis."

It is unnecessary to repeat the etiologic conditions already discussed. I would insist only on three essential factors: the altitude, the cold, dry climate, and the great clarity of the atmosphere in the places where these cases are seen. I stress the nonattenuating influence during the cold period—the greater part of the year—as well as the predominance during childhood and puberty.

To establish comparisons with vernal conjunctivitis, which in some aspects resembles and in others is very different from the "exuberant," it is necessary to point out interesting opinions of several of the numerous ophthalmologists who have studied the former: L. Wecker (Convention of the Ocular Diseases, Madrid, 1870) described vernal conjunctivitis as trachoma, which he calls a "second form or tiled granulations." Desmarres at this convention described cases under the name of "hypertrophic perikeratitis."

Panas (Leçons de Clinique Ophtalmologique, 1899), naming it "seasonal conjunctivitis," indicated that "the exacerbations correspond to the spring and the beginning of summer and last during the winter" recommending "change of climate and particularly staying in the high mountains," the season which is both temperate and humid, on the contrary being favorable to the evolution of the disease.

My teacher, Lapersonne (unpublished lectures in clinical ophthalmology), said: "The disease presents itself almost exclusively in spring; but Fuchs and Axenfeld have shown that during the winter the lesions of this conjunctivitis do not disappear, but persist, only with much less intensity. Mention has been made (he said) of the influence of light and heat in its growth; the influence of light denied by some authors, must nevertheless be considered as valid; the action of heat is probably real, but perhaps less powerful than that of light." And finally he referred to the possible influence of "ultraviolet rays, those most painful to the eye."

In the "French encyclopedia of ophthalmology," V. Morax described a "gelatinous coagulation that as a rule occupies *the whole circumference of the cornea,*" and whose coloration "is most frequently gray-blue like the opal"; concerning the state of the tarsus he noted "the milky tint, opaline, uniformly extended."

A. von Szily ("Diagnostic and therapeutic errors in ophthalmology," Barcelona, 1925) said: "The characteristics of this disease are the whitish aspect of the conjunctiva (as if milk had been instilled), the proliferation of the tarsal conjunctiva, whose hard and projecting papillae resemble a kind of mosaic pavement, and a hypertrophy of vitreous aspect of the pericorneal conjunctiva in which are seen certain denser and whitish spots called *points* of Horner-Trantas. The border of the semilunar fold often takes part in the process. The abatement in winter and the exacerbation in spring, or rather the periodical course of the disease, is a very typical characteristic."

Ginestous ("Ophtalmologie infantile," Paris, 1922) referred to it as "an affection of childhood," and in describing the pericorneal forms pointed out the *points of Horner,* the tarsal lesions *growing in pavement* (blocks), and *the milky aspect of the conjunctiva similar to a crust of silver nitrate,* as well as *superficial corneal lesions and round grayish parenchymal opacities* and *at times barely perceptible.*

Lenoble (Thèse de Paris, 1895) maintained that only the masculine sex is affected. Truc-Valude-Frenkel ("Nouveaux elements d'ophtalmologie") mentioned the tarsal prominence "as if covered by an opaline varnish," apart from the new growths at the border of the cornea.

Fuchs ("Textbook of ophthalmology"), contrary to all the authors cited above, in referring to what he called the perilimbal nodules, said that they persist throughout the years without appreciable modification, the subjective symptoms being those that are lessened in winter; and in respect to the tarsal lesions stated that over them "is extended a delicate veil of a bluish-white tint as if a thin layer of milk had been poured over the surface of the conjunctiva." And he qualified it as a "rather rare affection."

Saemisch (Graefe-Saemisch "Handbuch") insisted upon the relapsing character of vernal exacerbation and that *is found in all cases.*

Axenfeld is one of the authors who has studied "vernal conjunctivitis" with the greatest thoroughness, describing it in masterly fashion in his celebrated work, "Rapport à la Société française d'Ophtalmologie," in 1907. On analyzing extensively the causes of vernal catarrh he did not agree that sunlight is a determining

factor, as it established neither a parasitic nor microbic etiology. "I do not wish to deny," he stated, "the possibility that vernal catarrh might be a parasitic disease. Mechanical irritation may help its evolution in an already prepared field."

F. Terrien (Semiologie oculaire. La calotte corneosclerale," 1923) in this respect indicated the "papillary vegetations," the "milky tint" of the entire conjunctiva, and so forth, and suggested the influence of alterations of internal secretions "in the period of life in which the endocrine system is not particularly active and frequently presents functional upsets."

Lieutenant Colonel R. H. Elliot ("Tropical ophthalmology") mentioned its rarity in England; finding it at times in the ophthalmic clinics of India . . . "being most common in the rainy season and decreasing in frequency in the hot season." This is in disagreement with the general opinion, since its exacerbation in the rainy season would correspond to the cold and cloudy weather and its attenuation to the period of greater heat and clear sky.

Röhmer ("Ophthalmology," 1923) described the well-known aspect of the bulbar lesions. Referring to the aspect of the conjunctiva, he described it *as if it had been painted with milk*. He added: "These disturbances continue during the entire summer, diminish during the coldest and most humid days or weeks, and *usually disappear* as soon as the cold season arrives." In regard to its causes, he speaks of its being "a disease produced by light, and which may perhaps be attributed to the action of ultraviolet rays."

Marín and Amat maintained that "it is more logical to suppose that the spring exacerbations of the affection depend rather on heat rays than on light and chemical rays."

Carlos Charlin ("Clinica oftalmologica," 1925) describes the "caked and regular granulations in the conjunctival tarsus (leaving the cul-de-sac free)" and the pericorneal new growth of a yellow gelatinous aspect; and in regard to its evolution, he stated: "It appears in the spring, during several successive years, and disappears entirely or partially in the cold season. . . . It is attributed to a conjunctival allergic reaction provoked by vegetable emanations, and, as such, this conjunctivitis is similar to hay fever."

Argañaraz ("Practical manual of ophthalmology," 1932) wrote that "it is characterized by its appearance and recrudescence at the beginning and during the hot seasons (spring and summer), to recede and at times almost disappear during the winter." Regarding the tarsal alterations he alluded to the "bluish-white color that extends throughout the entire upper eyelid."

Chaves Velando ("Astigmatic syndrome," Lima, 1938), agreeing with the opinions of Dedimos, attributed vernal conjunctivitis to two causes: astigmatism and sunlight (abundance of ultraviolet rays, slightly penetrating). According to this theory of Dedimos, there is probably a slightly tonic stage, to which is added the influence of light, thus occasioning the hyperplastic alterations of the connective tissue.

Poulard ("Traité d'Ophtalmologie") said, "it appears at the beginning of spring and persists for a large part of the summer, to disappear completely in the winter. On the return of spring a new flare-up appears."

In concluding these citations from other authors I must refer also the opinion of Gabriélidès, who, except for Pascheff and Axenfeld, has devoted the greatest attention to the study of vernal catarrh.

This author noted the *rarity* of the condition in cold climates. "There are cases," he wrote, "in which the conjunctivitis has continued during the winter without at-

tenuation of symptoms, but they are very rare. I have been able to make only six such observations in all of our 85 cases. But as a general rule the symptoms and the volume of the vegetations diminish and at times even disappear with cold weather, to reappear again the following spring." He described the tarsal lesions as prominences having a pale milky aspect, or a uniform pale salmon tint, "the cul-de-sac always being spared." Regarding the bulbar lesions, his description referred to "grayish-white projections similar to wax, to lard, one finding at times "scarred conjunctival ridges." This last peculiarity is not mentioned by any other author, and it is possible that there is a diagnostic confusion with trachoma, a disease as common in Turkey as in other countries of Asia Minor.

The influence attributed by some authors to sunlight and particularly to a certain type of ray has already been mentioned. In general, it is attributed to the ultraviolet ray, except by Marín and Amat who emphasize the influence of heat rays. We know, on the other hand, that according to some of the most modern authors, certain disturbances of the endocrine glands—or allergic states, according to others—would bring about a condition in which light or heat alone would have a determining influence, a kind of clashing action in the region prepared by those factors.

Henri Lagrange in his important article "Conjonctivites catarrhales, anaphylaxie et troubles endocriniens" (Arch. d'Opht., 1922, November), after analyzing some very interesting clinical cases, wrote: "These simple clinical histories have encouraged us to undertake the study of vernal conjunctivitis in the light of the new hypothesis that *a state* of sensitivity constitutes its basis; that the latter is found in relation to a disturbance of the endocrine functions, and that the treatment of the disease should be undertaken with this in mind."

But something additional must be looked for in considering the nature of the disturbance that ends by engendering these ocular manifestations. In accord with our present knowledge the pathogenic interpretations may be placed in the following three categories:

a. *Allergy.* Influence of pollen, according to Lagrange and Delthil and the North American authors. Infectious allergy, according to Pascheff. Reaction of a toxic state, according to others who, like Gabriélidès, use the word "toxinical" to qualify the affection.

b. *Constitutional disease.* Diminution of calcium in the blood. Hereditary influences. Tuberculosis. Endocrine disturbances.

c. *Neuropathic changes.* Vagotonia according to the interpretation of Dedimos and the formula of Chaves Velando. Or rather, hypertonus of the vagus connected with genital and suprarenal hypofunction.

I find it necessary to refer with some emphasis to the concept presented by Chaves Velando. According to this author, the etiopathogenic cycle has *astigmatism* as an initial factor, which, in his opinion, is present in some cases; to this is added the *light* factor as a cause of the disturbance of the neuro-vegetative system, which initiates the conjunctival reaction. "I maintain on the other hand," he declared, "that vagotonus is secondary to the action of light on the astigmatism.... The causal connection is probably this: astigmatism, light that produces an unsteady, accommodating reflex, the nervous stimulus of the latter that is diffused abnormally at the vago-sympathetic centers, and the vegetative unbalanced state with ocular localization caused by the congestive conjunctival disturbances."

This interpretation of the above-mentioned author, acceptable as a hypothesis

in several of its fundamentals, seems to be unsupportable in regard to the initial role of astigmatism to determine the disturbances of the neuro-vegetative system and its consequences, the ocular lesions. It is enough to take into consideration the disproportion that exists between the great number of cases of astigmatism unaccompanied by vernal conjunctivitis observed daily in all climates and by all oculists, and the limited number of cases of the disease.

The predominance of the affection in males and in the infantile and adolescent ages, its frequent spontaneous disappearance in youth and the adult stage are facts of great value in deducing that the modifications of metabolism and the variations inherent in some endocrine functions, especially in those that become increasingly active at a certain period of life, are important. And the fact that this ocular affection is begun neither in adolescence nor in the adult stage strengthens this idea, for the cases observed in those periods of life began years before.

All the ideas analyzed here, although for the most part founded on observation, do not allow the formulation of more or less complete conclusions. There is still much to investigate, much to explain before the last word can be said.

The affection that I have studied, observed in the high regions of Bolivia, corresponds to the nosologic type called "vernal conjunctivitis." Is it a special type of disease, or is it a simple variation of vernal catarrh determined by peculiarities of climate, altitude, light, and numerous telluric circumstances which we cannot even appreciate but which, added together, determine the characteristics of each climate?

It is necessary to make the similarities and differences of both pathological states evident in order to arrive at conclusions, although these may be provisional.

In the first place the age and sex coincide as much in vernal conjunctivitis and in exuberant perikeratoconjunctivitis as do the severity and the spontaneous disappearance of the lesions in certain periods of life. In the same manner there is an analogy in the habitual lack of complications, in the bilateralness of the affection.

On the other hand, I should like to point out the following differences: (1) The most important is that in the cases observed, those in high and cold climates, the lesions do not show variations in any period of the year. Throughout its evolution—several years—there are no appreciable modifications, subjective nor objective, save the long and slow period of remission.

(2) Among my cases there are bulbar forms exclusively, without any alteration of the tarsal conjunctiva, without even the opaline, milky, bluish-white aspect or coloration on which all the oculists who are studying the subject have commented. On the other hand, among these there were 32 cases of the form catalogued as mixed; but I must point out that in the latter cases I include those in which the tarsal conjunctiva appeared slightly rough and reddish, with small round prominences, but so small that, besides being separate, they did not attain an important size and were very different, of course, from the "vegetations" of the flattened surface of the pavement contours of a pale rose or salmon color, or as if covered by a film of milk, opalescent, and the like.

(3) The new formations that I call "juxtalimbal" are not situated at the limbus but invade part of the corneal tissue. I have made note—an observation hitherto undescribed—of the dark, more or less shadowy, and even chocolate coloration, a color that can exist as a definite residue when the new growths have retrogressed.

(4) I have pointed out that in some cases, either before the disappearance of the new formations or after, when the retrogression begins, the peripheral infiltrations of the cornea are present, either semilunar, in the internal and external portions, or forming a complete circle resembling in its arrangement the arcus senilis, but in such cases wider at the ends of the horizontal diameter. Regarding the difference of the punctiform, rounded disseminated grayish infiltrations, which the majority of authors point out in vernal conjunctivitis, those that I have encountered differ, in addition to the curious semilunar form, by their brilliant aspect, silver or nacreous (fig. 4).

(5) In my cases no condition resembling the "points of Horner-Trantas" was found.

(6) The arrangement of the blood vessels of the new formations, which I have already described, and which, in general, course toward the respective palpebral angles, is a special characteristic.

(7) The pathologic anatomy shows that in vernal conjunctivitis there is in the first place a "coagulation of the epithelial layer by multiplication of cells" (L. Genet). The separate findings of various investigators and the report from Lascano Gonzalez on the specimens of the new growths that I sent him, establish the differences in histopathologic structure. As a fact of great importance, in vernal conjunctivitis the predominance of eosinophiles in the sections contrasts with the rarity of those cells in the tissue of exuberant perikeratoconjunctivitis, which, as the cited anatomopathologist says, "is an inflammatory granuloma of subacute evolution."

For my part, with the privilege of changing my opinion if new facts and other data that may be gathered in the future induce me to do so, I think that this is an affection that must be differentiated from vernal catarrh and considered as a particular nosologic entity.

Regarding its nature, I believe it is determined by a true etiopathogenic complex that could be classified in the following three groups: (a) Influence of climate, of altitude; light surely an important role, and especially a particular type of actinic ray. (b) Possible endocrine dystrophies and disturbances of the metabolism. Perhaps also a certain vitamin deficiency. (c) Allergic states, not dependent on seasonal influences, but of a *permanent* character.

None of these groups could be declared responsible in itself. It is more probable that they all take part, groups (b) and (c) having the role of preparants or predisposers, climatic conditions being the determining factor.

Calle San Alberto 28.

Discussion

Dr. Edward Jackson: The paper by Dr. Solares describes a new clinical entity that deserves careful attention. As he says, it resembles what has been known as vernal conjunctivitis. But it differs enough from that condition to be carefully considered both with reference to what the two conditions have in common and the points in which they seem to be quite different. My own experiences of vernal conjunctivitis include cases seen in Philadelphia near sea level and in the region of the Rocky Mountains at elevations of 2,000 to 3,000 meters above sea level. Vernal conjunctivitis is more common in Denver, with its dry climate, than it is near sea level either at Philadelphia or on the shores of the Gulf of Mexico. Cases occuring in Texas and Colorado have escaped recurrences when the patients removed to the cooler moist regions of the North Pacific Coast.

Less seasonal variation would be expected in the mountains of Bolivia, lying in the tropics; and the air of high altitudes cannot possibly carry the moisture that it does near sea level. These conditions might explain absence of the seasonal contrasts this keratoconjunctivitis shows in comparison with the characteristics of vernal conjunctivitis as we know it. The influences of differences in racial constitution must also be considered in comparing the manifestations of the two disease conditions.

Dr. Solares did not observe in his cases features prominent in vernal conjunctivitis, which begins and grows worse during childhood and often disappears in adult life. Also that it may appear in different generations of one family and not at all in other families living under the same conditions

Vernal conjunctivitis is totally different from trachoma, although the two have been confused. The involvement of the palpebral conjunctiva leading to such confusions seems to be absent from the disease that Dr. Solares describes. The similarities of this disease in Bolivia with what we have encountered in the southwestern part of the United States would justify the trial of treatment of the Bolivian disease by radiation both by roentgen rays and radium, which have proved so effective in vernal conjunctivitis.

Radiations from the sun include such an enormous range of wave frequencies; some of them hitherto unsuspected may be the cause of the disease that has been brought to our attention and the therapeutic influence of other radiations might well be tried for the relief of the condition we are considering.

CAPSULOTOMY AND IRIDOCAPSULOTOMY

TECHNIQUE WITH A SPECIAL KERATOME AND IRIDOCAPSULOTOMY SCISSORS*†

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One of the most gratifying operations from the standpoint of the patient and the surgeon is the successful formation of an artificial pupil, especially when both eyes are involved or when the vision of one eye has been lost. A satisfactory pupil is sometimes difficult to obtain. In certain cases of sympathetic ophthalmitis, six or seven operations have failed.

Before describing the method employed, it may be profitable to consider secondary membranes, in general, and some of the surgical techniques that have been most generally accepted. If the secondary membrane is only a cobweb, a single incision or Ziegler inverted-V incision[1] with a Ziegler knife needle is permissible. The method of cutting the secondary membranes with a "ground down" cataract knife, introduced through the cornea, was originally practiced by Hunter and later modified by Wheeler,[2] who used a special narrow knife, 18 mm. by 1 mm. tapering to a point. The knife is introduced through the cornea 1 mm. from the limbus, and the membrane is cut by a sawing movement of the knife, in and out of the vitreous. The use of a knife to cut dense membranes has several disadvantages: (1) Traction on the ciliary region and disturbance of the vitreous may result. (2) Other incisions in the membrane may be difficult to make if the first fails to produce a satisfactory opening. (3) Danger of infection may be greater from the corneal incision. However, if the membrane is at all dense, it is advisable to avoid traction on the ciliary region by cutting the membrane with scissors.

The use of De Wecker scissors[3] after making a corneal or subconjunctival wound at the limbus with a keratome has long been practiced with excellent results. However, these scissors have been found unsatisfactory in certain cases because (1) a large incision in the sclera or cornea is required, (2) the angle formed by the blades and the shaft makes them difficult to manipulate, and (3) the blades are too short to cut some membranes satisfactorily. The Noyes scissors[4] are more satisfactory than the De Wecker scissors but are also difficult to manipulate because of the necessity of maintaining pressure to keep the scissors closed.

This difficulty has been overcome and several other improvements have been made in the iridocapsulotomy scissors which have been developed.

The technique to be described has been so satisfactory that a brief description of the operation seems justified.

INDICATIONS FOR CAPSULOTOMY AND IRIDOCAPSULOTOMY

Capsulotomy and iridocapsulotomy are indicated: (1) in cases of secondary cataract in which the membrane is dense and firmly adherent to the iris; (2) if the pupil is either displaced or contracted; (3) if the pupil has become obstructed by a membranous exudate; (4) if the iris is partially or totally adherent to the wound; (5) if the eye has had attacks of iridocyclitis, when iridotomy may be performed below without cataract extraction

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or at the time the lens is extracted;[5] (6) in some cases of traumatic cataract with unabsorbed lens fibers.

Capsulotomy and iridocapsulotomy with scissors are indicated in all but the most delicate membranes where there could be practically no traction on the ciliary body or injury to the vitreous. The more experience one has with the needling of secondary membranes the more one is convinced of the danger of postoperative inflammation from traction on the ciliary body and of the possibility of producing detachment of the retina.

Contraindications for capsulotomy and iridocapsulotomy

Iridocapsulotomy and capsulotomy should not be performed in cases of hypotony, which is often present in cases of atrophic iris and fluid vitreous, until every effort has been made to raise the intraocular pressure. In some cases of atrophy of the iris in which the membrane is dense and not under tension, satisfactory results will not be obtained from iridocapsulotomy, for the incision will not gape. In these cases iridectomy and capsulectomy may be indicated, if the wound does not remain open. In cases of uveitis or iridocyclitis, the operation should not be performed for at least six or eight months after all biomicroscopic signs of inflammation have subsided. It is advisable to instill a drop of 1-percent solution of holocaine in each eye and to compare the congestion produced in order to determine freedom from abnormal congestion.

Preparation of the patient for capsulotomy and iridocapsulotomy

The pupil is dilated as completely as possible by the use of atropine combined with subconjunctival and local administration of epinephrine hydrochloride. Local anesthesia with pontocain and subconjunctival injection of procaine is usually sufficient except in small children. A retrobulbar injection should be administered if the eyeball seems to retract. If there is a tendency to squeeze the eyelids, anesthesia should be combined with akinesia of the eyelids.

Instruments for capsulotomy and iridocapsulotomy

The following instruments are used in this operation: speculum with solid blades,[6] fixation forceps which engages the episclera, narrow hollow-ground angular keratome,[7] iridocapsulotomy scissors,[8] and iris spatula (fig. 1).

Technique of capsulotomy and iridocapsulotomy

The operation is performed in two stages: (1) incision of the sclera, and (2) incision of the membrane.

(1) Incision of the Sclera. The position of the incision depends upon several factors, one of which is the direction in which the iris and lens capsule are drawn. In order to cause sufficient gaping of the wound, the scleral incision should be made so that the bands that are under the greatest tension will be cut at right angles. As the wound in cataract operations is usually above and the iris is drawn upward, the scleral incision is most frequently made at the temporal end of the horizontal meridian of the cornea, about 1 mm. in the sclera. In cases of simple secondary cataract without incarceration of the iris, the incision may be made above the old scar.

The conjunctiva is dried, and a 1:125 solution of azochloramide in triacetin is applied, 3 mm. from the cornea, where the conjunctiva is to be nicked with scissors, and azochloramide is applied to the wound. The conjunctiva is held away from the sclera while the angular keratome is passed through the sclera. Care should be taken to avoid injury to the iris. When the

point appears in the anterior chamber the handle is slightly lowered so that the blade is parallel to the plane of the iris. The keratome is thrust forward making an incision about 3 mm. long. If a large scleral or iridotomy wound is indicated, the handle of the keratome should be raised and the point passed through the membrane, and the blade should be pushed laterally as the vitreous is penetrated (fig. 2). The keratome is then slowly withdrawn with one side of the blade against one angle of the wound and the point toward the cornea. The aqueous may escape slowly and the membrane may be displaced forward against the cornea.

(2) Incision of Membrane. The special iridocapsulotomy scissors are inserted into the anterior chamber with blades closed. When the opening in the membrane is reached, the blades are slightly opened, and the sharp blade is passed through the opening behind the membrane, and the blades are then allowed to close by the action of the spring (fig. 3). Since the scissors at their joint completely fill the scleral opening, loss of vitreous is likely to be slight. If the single incision does not produce a satisfactory opening in the iris and capsule, lateral cuts may be made from the sides of the original wound. This procedure is facilitated by the curve of the blade. The edges of the conjunctival wound are drawn together with forceps after the operation.

(a) Position of the Incision in the

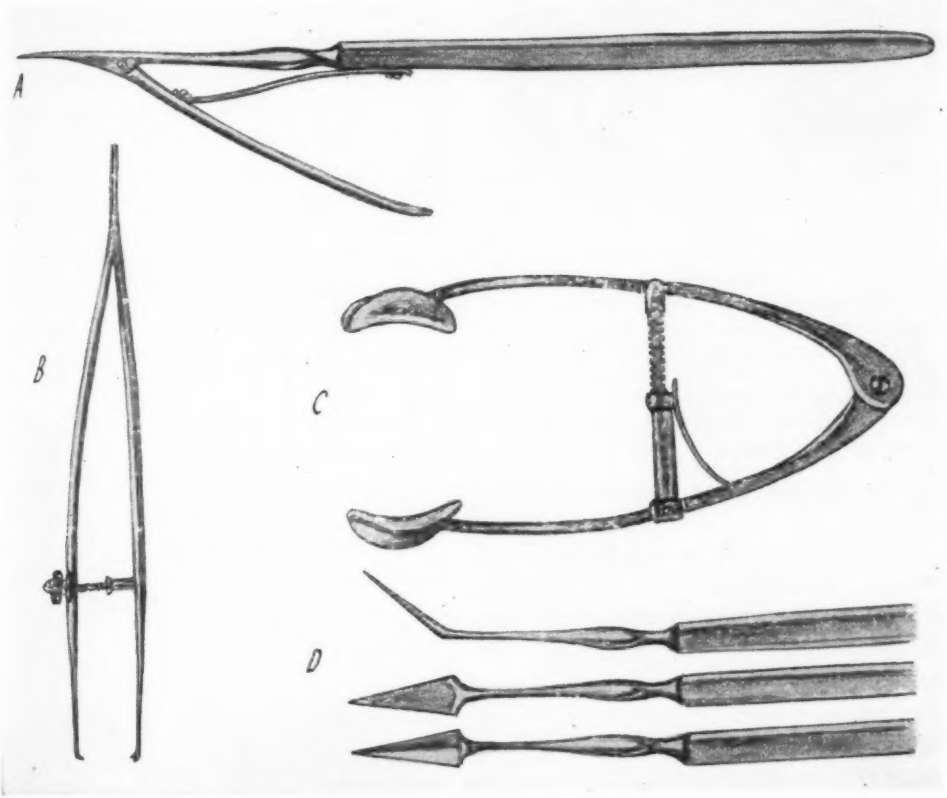

Fig. 1 (Berens). Instruments for iridocapsulotomy. A, iridocapsulotomy scissors; B, scleral fixation forceps; C, speculum with solid blades; and D, narrow hollow-ground angular keratome.

Membrane. Variations in the position of corneal scars, the traction of scar tissue, and the position of normal or newly formed blood vessels often necessitate a change in the position of the scleral and

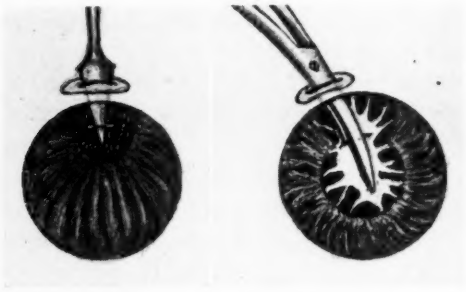

Fig. 2 (Berens). Iridocapsulotomy keratome incision (front view). The keratome has entered the anterior chamber and the point has penetrated the secondary membrane.

Fig. 3 (Berens). Capsulotomy with scissors. One blade of the iridocapsulotomy scissors is shown behind the membrane after it has been introduced through the keratome opening in the sclera and membrane.

capsular incision from the one shown in figures 2 and 3.

A common condition following loss of vitreous, postoperative inflammation, and prolapse of the iris is the drawn-up pupil shown in figure 4A. The position of the incision in the sclera, iris, and capsule may be visualized by reference to the figure. When a scar fills the pupillary space and the nasal quadrant is clear, the incision has been placed successfully, as shown in figure 4B. When the pupillary space is filled with an organized exudate but the iris is not on tension, a vertical incision may have to be made from below. In one case it was necessary to fill the anterior chamber with half-strength physiologic saline solution several times before the sharp blade of the scissors could be inserted through the keratome incision in the iris. If the capsular remains are unusually dense and flaccid, two cuts may be made with the iridocapsulotomy scissors A punch[9] may be used to excise the central part of the membrane after making the keratome incision through the sclera and the membrane. However, gravity and traction will usually produce a satisfactory pupil.

Complications associated with capsulotomy and iridocapsulotomy

Loss of vitreous is the most important complication that may occur during the operation. It usually appears after the membrane is cut. If care is taken not to exert undue pressure on the eyeball, vitreous loss is slight because of the fact that the iridocapsulotomy scissors almost completely fill the small opening in the sclera. The seriousness of this complication may be lessened by the use of the special fixation forceps that engage the episclera and lessen pressure on the eyeball.

Iritis and iridocyclitis may result from injury occurring during the operation.

Hemorrhage during or after the operation may be a serious complication, but even massive hemorrhages that fill the entire chamber usually absorb leaving practically no evidence. Cutting the iris with scissors seems to aid in preventing

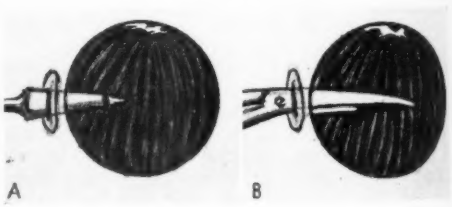

Fig. 4 (Berens). Iridocapsulotomy following cataract extraction. A, subconjunctival and scleral keratome incision in the horizontal meridian of the cornea; B, iridocapsulotomy scissors cutting the iris and capsule.

hemorrhage. Excluding infection, detachment of the retina is the most serious postoperative complication, but fortunately this has not occurred in any of the operations I have performed with the scissors. However, I have had this un-

fortunate complication in two patients in whom the Ziegler knife was used. In cases in which glaucoma develops, the aspiration[10] of 0.25 or 0.50 c.c. of aqueous will usually be all that is required.

Postoperative Treatment

The patient should be kept in bed for 24 hours with a light dressing on the eye operated upon. On the first day following operation he may sit up in a chair. The dressing is removed the morning after the operation and 3-percent atropine is usually instilled if the iris has been cut. If only capsulotomy was performed, atropine may be unnecessary.

Summary and Conclusions

The successful production of an artificial pupil often means restoration of vision to a patient who otherwise would be blind. For this reason every effort should be made to avoid serious complications. The opinion is expressed that all but the finest capsular membranes should be cut with scissors because of the great danger of traction on the ciliary region with resulting iridocyclitis and possibly detachment of the retina. A sharp hollow-ground narrow keratome is used to penetrate the sclera subconjunctivally and to perforate the iris and capsule. The incision in the iris and capsule is made with iridocapsulotomy scissors (modified Noyes) which fill the scleral opening and are easy to manipulate. The position of the incision in various conditions, which have been encountered, is described and illustrated.

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ON THE MECHANISM AND CAUSES OF HYPHEMA AFTER CATARACT EXTRACTION*

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Hyphema ranks midway between the serious and trivial complications of cataract surgery. It is always bothersome to both patient and surgeon. It is discouraging and depressing to the former because it generally occurs after the eye seems to be out of danger and doing well; and troublesome to the latter because he is aware that in a few cases at any rate, serious damage might have been done, or further complications arise.

In 1933, in my candidate's thesis for the American Ophthalmological Society, a study of the problem was presented. More or less buried as it is in the Transactions of the Society, the conclusions reached have probably not become familiar to ophthalmologists in general. For this reason it seems advisable here to review and summarize this article before proceeding to more recent studies, not because the findings hitherto reported by me are the last words by any means, but because there have been relatively few papers in the literature dealing with this subject alone, either before or since the appearance of my article.

A unique opportunity was presented in the original study in that a comparison could be made between two large series of private patients, operated upon in the same private hospital under identical conditions of hospital care and nursing. The work was done by my father and myself, each employing a different technique. Eight hundred and ninety cataract eyes operated upon by Vail, Sr., between 1916 and 1927, were compared with 510 patients operated upon by me between 1925 and 1933.

Vail, Sr., did not employ akinesia of the lid nor a conjunctival flap or suture. He made a corneolimbal incision, finishing his incision vertically through the cornea at the 12-o'clock position (classical Smith incision). A small iridectomy was then made. In 216 cases (24.2 percent) the Smith intracapsular procedure was used. In 262 cases (29.3 percent) the lens was dislocated with forceps and expressed in the capsule. In many of these cases the capsule ruptured, after which it was seized with forceps. The remaining cases were of the capsule-stripping (forceps) type, with the expression of the nucleus, irrigation of the anterior chamber, and recovery, many times, of capsular remnants with forceps introduced into the anterior chamber. Careful reposition of the iris pillars followed.

Vail, Jr., used Van Lint's method of akinesia, Angelucci's suture through the superior rectus muscle, Verhoeff's small conjunctival flap and scleral suture, a corneoscleral incision, small iridectomy, and attempted Smith expression. This succeeded in 127 cases (24.9 percent). If, after attempting the Smith operation, it was decided that too much pressure was necessary, Verhoeffs anterior-capsule forceps were applied to the capsule just below the lower edge of the iris, and the lens was dislocated successfully in 176 cases (34.5 percent) and expressed as a tumbler (Knapp-Stanculeanu method). In the remaining cases—except for 21 spoon or vectis deliveries—the anterior capsule was stripped, the nucleus was expressed, the suture was tied, the anterior chamber was irrigated, and the capsule remnants

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were, in many instances, removed with forceps. A careful toilet of the wound followed, and the eye was closed gently and held closed with 0.5-percent yellow oxide-of-mercury ointment on the lashes and lower lid.

Vail, Sr., instilled a drop of 1-percent atropine solution in all cases. Vail, Jr., instilled a drop of 0.25-percent eserine-salicylate solution in the intracapsular cases and a drop of 1-percent atropine sulphate in the extracapsular ones.

Both operators employed the same aftercare. Both eyes were closed with thin cotton and gauze eye pads, and a firm binocular cloth mask was tied on and held in place with adhesive strips across the brow and mask. In the intracapsular cases the bandages were not disturbed for four days after the operation, and in the extracapsular cases they were allowed to remain in place for three days, after which time daily dressings were made. The patient's hands were tied at night for 10 nights. The eye that had not been operated on was uncovered on the seventh day after the operation, and the patient was kept in the hospital for a period of two weeks in every instance, unless some complication prolonged his stay.

Since the aftercare was exactly the same in these two series and the percentage of intracapsular and extracapsular cases was approximately the same, the marked difference between the occurrence of hyphema between the two series can be

TABLE 1

INCIDENCE OF HYPHEMA AFTER CATARACT EXTRACTION

Author	Form of Extraction			
	Simple	Combined	Various	Intracapsular
	Percent	Percent	Percent	
Knapp, H.,* 1890	1.0	4.6	...	
Snellen, 1869	...	3.4	...	
Derby, H.	...	...	6.0	
Strawbridge	...	...	1.92	
Neve	4.0	...	...	
Arnold	...	6.5	...	
Marshall	...	...	1.25	
Schreiber	...	...	8.27	
Köllner	...	5.2	...	
Uhthoff	115 diabetic patients		8.9	
Hassigs	...	...	10.0	
Leipzig Clinic	...	...	3.5	
Seefelder	...	...	12.6	
Barkan, H.	...	...	10.8	
Von Grosz	...	...	8.0	
Flaschenträger	...	...	5.3	
Birch-Hirschfeld	...	...	4.1	
Cousin	...	...	9.0	
Carle	...	...	18.7	
Gasteiger	7.0	13.0	10.0	
Jensen	...	...	17.5	
Knapp, A.	...	...	...	300 cases 6.0 percent
Mohilla	...	...	9.2	
Wheeler	3.9	6.9	4.5	
Wickerkiewicz	After open treatment		3.6	
Philps	...	...	13.1	374 cases
Vail	1,185 cases		6.4	
Average			7.9	

* References to this and the succeeding citations in this table will be found in the bibliography of reference 1.

explained only on the basis of the type of incision and the employment of wound sutures.

Frequency of postoperative hyphema: Vail, Sr., 11 out of 890 cases, or 1.23 percent. Vail, Jr., 27 out of 510 cases, or 5.29 percent. Vail, Sr., intracapsular cases, 2, or 0.4 percent; extracapsular cases, 9, or 2.1 percent. Vail, Jr., intracapsular cases, 21, or 6.9 percent; extracapsular cases, 6, or 2.8 percent.

Frequency of iris prolapse: Vail, Sr., 62 out of 890 cases, or 6.9 percent. Vail, Jr., 15 out of 510 cases, or 2.9 percent.

Time of filling of the anterior chamber: Vail, Sr., 33 percent of the anterior chambers were empty at the end of 5 days, 2 percent still empty at the end of 10 days. Vail, Jr., 96 percent of the anterior chambers had reformed at the end of five days.

It is well known that delayed healing of the wound is most common in the cataract cases in which the corneal incision is used (Widmark, Meller). In addition to leading to many complications—hernia of vitreous, glaucoma due to retained capsular fragments, epithelial inclusions or downgrowth, anterior synechiae, fistulas and opacities of the cornea—delayed healing probably serves one good purpose, if any deduction can be drawn from a comparison of the two types of operations described; this is the prevention of too rapid filling of the anterior chamber by constant leakage of aqueous, precluding the springing open of the wound edges and hyphema.

A study of the foregoing statistics suggests therefore that hyphema occurs most often when the anterior chamber fills rapidly and is in indirect ratio with the frequency of iris prolapse; that is to say, the more cases of iris prolapse the fewer of hyphema. It can be logically assumed, therefore, that the iris prolapse acts like a plug or tampon, producing hemostasis on the ruptured newly formed capillaries.

Philps has recently pointed out that hyphemata could be divided into three groups:

1. Those occurring at the time of operation, from the conjunctival flap. These absorb very rapidly and unless they are very large will have disappeared by the time the first dressing is done 48 hours later.

2. Those occurring for the first time several weeks after the operation concurrently with an attack of iritis. They are prone to recur at frequent intervals. These may be considered inflammatory in origin.

3. Those occurring between the second and tenth postoperative days, almost invariably between the second and sixth. It is only very rarely that more than a single hemorrhage occurs, and the eye is usually free of blood in two to three weeks.

Because of the prevailing belief, which I think erroneous and difficult to overcome—namely, that hyphema is due to the cut iris—it seems wisest here to review a few facts about wound healing after cataract surgery. Henderson, in 1907, pointed out that the healing process in incisions made through the limbus differs from that in the case of corneal wounds, being modified by subconjunctival tissue. In the corneal incision the margins of the wound are glued together by: (1) fibrinous exudate (mediate union); (2) the ingrowth of corneal epithelium (primary union)—in this growth of the epithelium there are great variations in different patients; (3) growth of corneal fibers, which is not fully accomplished within two or more months (permanent union). In limbal incisions union is due to downgrowth of subconjunctival tissue. The resulting cicatrix is broader and more apparent than that following a purely corneal incision.

Treacher Collins gave additional details regarding the healing of limbal wounds, which should be emphasized. "After an

incision through the limbus with conjunctival flap there is retraction of the anterior and posterior layers of the sclerocorneal tissue, and the formation of wedge-shaped spaces, just as after an incision through the cornea. The anterior wedge-shaped area does not, however, become filled with epithelium. In consequence of the conjunctival flap, the opening in the epithelium does not correspond in position with the opening in the fibrous tissue. What extends down the wedge-shaped area anteriorly is the subepithelial vascular tissue of the conjunctiva."

Tooke found that this proliferation of subconjunctival tissue and new blood vessels was present in the wound at the end of two days. Czermak and Birch-Hirschfeld believe that more cases of wound reopening occur in corneal incision than in conjunctival incision. That this is true is borne out by clinical experience of the delayed and proper closure of the wound in such cases. By the same token, reopening of a relatively avascular wound would explain the lessened incidence of hyphema in such cases (that is, those of purely corneal incision). Czermak found that healing of the outer wound in the conjunctiva begins in 24 hours and healing of the inner wound in about three days.

Bleeding into the anterior chamber can come from the following sources only: (1) from the conjunctival (limbal) newly formed blood vessels; (2) from the iris and ciliary body; (3) from a choroidal detachment. The evidence for the premise that hyphema is from the ruptured newly formed blood vessels is founded on: (1) The reported findings and personal experience of the observation of blood trickling down from the limbus at the time of the first dressing coincident with the patient's squeezing his lids and complaining of a sharp pain. (2) The observation that following hyphema of the type under discussion, the conjunctival flap and the line of the incision invariably appear congested and edematous; a close inspection will often reveal blood clot, large or small, within the anterior chamber adhering to the wound. (3) The somewhat negative evidence that hyphema is seen just as frequently after iridotomy and simple extractions as after iridectomy (Philps). (4) Cases of iris prolapse are seldom associated with hyphema because, as was mentioned before, the iris in such event acts as a blood-vessel tampon. (5) Hyphema is more rare in cases of corneal incision because here, due to the delayed closure of the wound and relatively avascular type of its healing, the internal edge eventually becomes more solid than the external edge.

In a relatively few number of cases repeated hemorrhages into the anterior chamber are seen; these may continue long after the wound may be presumed to have healed. In this event it seems logical to assume that the bleeding is from the iris, not necessarily the cut edge only, but more likely from the stroma. It is indicative of an inflammatory reaction or increased fragility of the vessels. The blood is always thinner, of paler color, and remains longer than in hyphema of the nature previously discussed. This would likewise explain why, in the past, diabetes has been assumed as the most frequent cause of hyphema. A review of the most recent literature and a study of my own cases do not support this conclusion. Philps, for example, had 5 diabetic cases out of 49 cases of postcataract hyphema, which is approximately the ratio of diabetics to nondiabetics in all cataract extractions. Three out of four of his patients who bled from the iris were diabetics. In my first series of 38 cases, 2 patients had diabetes (5.3 percent). In the series about to be reported 3 out of 49 patients were diabetics (6.1 percent).

Finally in a few cases, which will be

Fig. 1 (Vail). Occurrence of hemorrhage in the author's combined series.

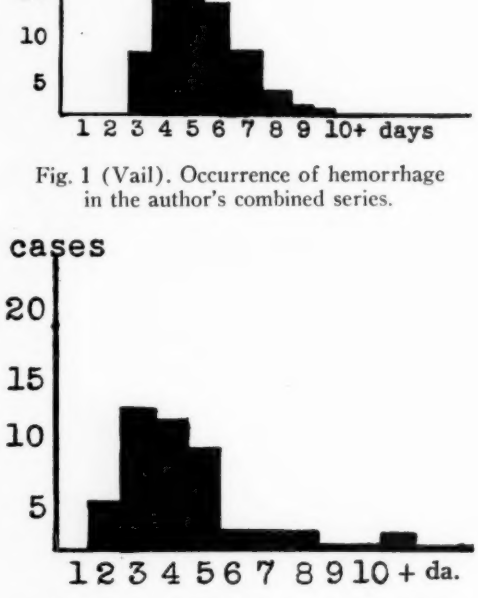

Fig. 2 (Vail). Occurrence of hemorrhage according to Philps.

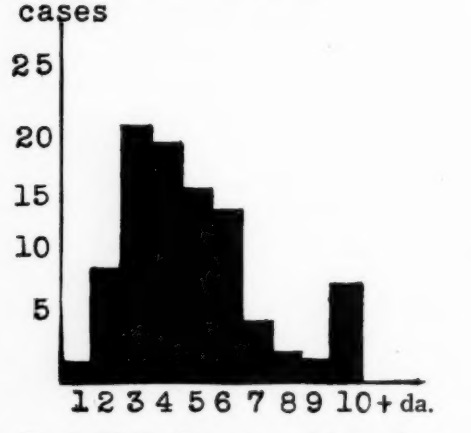

Fig. 3 (Vail). Occurrence of hemorrhage according to Wheeler.

dealt with later, hyphema occurs as the result of cyclodialysis and choroidal detachment. These can be recognized potentially by the marked deepening of the anterior chamber prior to hemorrhage and probably result in the most serious complications interfering with the final vision.

The accumulating evidence therefore is strongly in favor of the premise that hyphema comes from the healing wound. An increasing number of authors, students of the question, incline towards this belief, among whom are Herbert, Cousin, Birch-Hirschfeld, Carle, Worth, Czermak, Elschnig, Fleischer, Schanz, Wickerkiewicz, Meller, and Philps.

An analysis of a second series of cataract operations was made since the previous study, to see if more light could be thrown upon the subject. From March, 1933, to January, 1940, 675 cataract extractions were performed by me at the Holmes Hospital, Cincinnati, under essentially the same conditions as in the previous series. The same operative and postoperative technique was employed. Of these, 426, or 63.1 percent, were intracapsular, the remainder extracapsular extractions. Twenty-six of these patients were diabetics. There were 49 cases of hyphema or 7.2 percent of all cases, compared with an incidence of 5.3 percent in the first series. In the combined series there is an incidence of 6.4 percent, which compares with the average of all available figures (table 1) from a review of the literature of 7.9 percent. It is interesting to note here that Uhthoff reported 8.9 percent of 115 diabetic patients had hyphema, indicating again that diabetics are probably no more prone to hyphema than are other patients.

The hemorrhage generally occurs from the third to the sixth day. In my first series in 25 out of 38 cases the hemorrhage occurred on the fifth or sixth day. In the second series, in 33 out of the 49

cases the hemorrhage occurred on the fourth to sixth day. A graph (fig. 1) of the total of the two series agrees very closely with that copied from Philps (fig. 2) and Wheeler (fig. 3). They show that the critical time for the occurrence of the hemorrhage is from three to six days. Other authors mention this period as well (Civetta, Cousin, Gasteiger, Herbert, A. Knapp, H. Knapp). Worth even goes so far as to give the time as almost exactly 120 hours after the operation. This coincides with the times of the first and second dressings of the eye, which may have considerable to do with its onset, either through squeezing, flinching, or exposure of the eye to light. Several writers including the author have noticed, at the time of the first or second dressings, the appearance of blood coming from the wound, seeping across the iris surface and coming to rest in the anterior chamber usually associated with an exclamation of severe pain by the patient. Five such instances were seen by me in the last series, four in the first, and unpleasantly convinced me that the bleeding came from the wound.

The role of trauma

It stands to reason that trauma—such as squeezing the lids, rolling the eyeball, poking, jabbing, wiping, or pressing the eyeball—should result in wound reopening and hyphema. But that it does not always do so is the important factor. Each surgeon can recall from his own experience cases of senile dementia, gross misbehavior, and physical violence to the eye without any hyphema or other damage ensuing. Such a history of trauma was found in 44 out of the 87 cases in the combined series. This, however, leaves more than half of the cases the result of an unknown cause. Some of these (six in the last series) were of the repeated thin-blood type, explained on an inflammatory basis, either the result of iritis caused by the operation, or iritis the result of the toxic effect of the blood.

The remaining group, more than half of which occurred during the night when the patient was quietly resting, are of the greatest interest because they are difficult to explain. A few of these patients recalled a nightmare or upsetting dream.

The role of the intraocular pressure

Until we know more of the character and nature of the re-formed aqueous after paracentesis or other intraocular operations, including cataract—studies, for example, such as Kronfeld is presently engaged in—our knowledge of what goes on must be purely conjectural. There is experimental evidence (Kronfeld) that secondary elevation of tension occurs when the aqueous re-forms. This is supported clinically by the hazardous taking of tension on the third, fourth, or fifth days after cataract extraction. I have performed this in 12 cases of uncomplicated healing, using the Souter or spring tonometer, with much fear and trepidation. The Souter normal is 12 mm. Hg. In six of these cases there was a tension of 14 mm. Hg, in one case a tension of 16 mm. Hg, and in one of 18 mm. Hg or possibly 20 mm. Hg, since I was afraid to press harder. In the remaining four cases there was normal tension (12 mm. Hg). The length of time that this increased tension exists after operation is unknown. In the uncomplicated case the tension, taken with the Souter tonometer 10 days after operation, has always been normal.

It was also found that the tension when taken after the hemorrhage had occurred was subnormal and remained so for several days, presumably due to leakage through the reopened wound, or, as E. Fuchs suggested, a detached choroid.

If, then, it can be assumed that after the anterior chamber is re-formed there

is an increased intraocular pressure, either as a result of a different chemical constitution of the aqueous or an overfilling of the chamber, as shown by a deepened chamber (which was observed in a few of the cases of hyphema prior to the hemorrhage), a "constitutional moment" is set up. Then the slightest pressure exerted either by the lids or movement of the eyeball might be just enough to overcome the wound pressure, and result in its reopening with laceration of the newly formed blood vessels and hyphema. Such a constitutional moment would explain the cases of iris prolapse, with or without hyphema. Along this line I would mention that only 3 out of the 49 cases in the second series showed iris prolapse.

It can also be argued that the use of conjunctival-scleral, or corneoscleral sutures, by tightening and approximating the wound edges firmly, predispose to the early development of the constitutional moment (re-forming of the anterior chamber and increase of the intraocular pressure). This is supported by the statistics cited.

It has been possible as a result of a study of this and other series, as well as a review of the literature, definitely to rule out age, sex, seasonal incidence, albuminuria, diabetes, or vascular hypertension as potential factors. The blood dyscrasias may play a role, although there are cases reported in the literature in which hyphema did not occur after cataract extraction.

Carle explains the mechanism of wound reopening as follows: "Following operation the intraocular tension is lowered markedly. A large part of the ocular contents, lens, aqueous, and in a few cases perhaps a little vitreous, are lost. Following the operation the anterior chamber is comparatively quickly re-formed, but normal tension is in no way restored. When one closes the eye and applies a bandage, the eyeball, as a result of this pressure, is deformed. The wound edges will be displaced one on another, and in this position more or less sealed. In the beginning the wound leaks, but the leakage quickly stops and the pressure rises again. When the pressure begins to reach normal, the eyeball assumes a spherical shape again. Thereby ensues a stretching of the somewhat strongly healed wound edges, the wound springs open and a hemorrhage occurs in the anterior chamber."

On the other hand Philps maintains that "owing to the tension of the eye a cataract section always gapes to some extent, and this gap is made good by young vascular tissue. Should the patient now squeeze his lids, this will cause deformation of the eyeball and separation of the wound edges and thus rupture the young vessels uniting them."

If these explanations were correct one should expect hyphema in practically every case. If sutures are used and badly approximated, this factor might have some bearing on the onset of hyphema; but on several occasions after tying the suture, lines of tension have been noticed in the cornea. In none of these cases has hyphema been observed.

It is beyond the scope of this paper to discuss the method of absorption of the blood, as well as the complications as a result of hyphema. It may be briefly mentioned that aqueous humor has no action on red cells, but can dissolve fibrin from the clot. The cells are absorbed by the iris, and do not enter the canal of Schlemm (Thomas, Philps). Hyphema takes about three weeks to disappear. The complications are (1) iritis; (2) blood staining of the cornea, anterior surface of the vitreous, and occasionally within the vitreous body itself where it may remain for months; (3) blood, cortical substance, and posterior capsule forming a thick tenacious membrane, secondarily

vascularized in many instances; (4) detached choroid; (5) glaucoma, due to adherent iris root or following accompanying iris prolapse.

Conclusions

1. Hyphema is the result of wound reopening and the rupture of newly formed corneo-episcleral blood vessels at the section. In a few cases it results from rupture or diapedesis from diseased iris vessels, as a result of inflammation. In this event it is apt to be recurrent.

2. In many instances direct trauma is the chief cause of the rupture. In approximately 50 percent of the cases, no such history can be obtained. Likewise, there are many cases on record in which severe and often direct trauma did not produce hyphema.

3. The theory is advanced that an increase of intraocular pressure and/or an overfilling of the anterior chamber constitutes a "constitutional moment" when even the slightest lid pressure would be a sufficient increment to cause the wound to reopen.

4. The "constitutional moment" occurs between the third and sixth postoperative day.

5. Hyphema and iris prolapse have an incidence of inverse ratio. The iris acts as a tampon on the ruptured newly formed blood vessels.

6. Approximately in 8 percent of cataract extractions hyphema develops (all sources).

7. The cause is entirely local. Constitutional factors, including diabetes, play no part.

8. Hyphema is rare in a purely corneal section, the healing of which is almost avascular.

9. The type of operation (intra- or extracapsular) has no influence on the incidence of hyphema.

10. Preventive treatment is important. The use of multiple corneoscleral sutures is advocated. The patient must be carefully watched and nursed for at least the first seven days; the time of the first dressing is a critical one.

11. A study of a second series of 675 cataract-extraction cases confirms the author in the conclusions he reached in 1933.

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Discussion

Dr. Harry S. Gradle, Chicago: This discussion is in the nature of a preliminary report upon some investigative work upon which we are now engaged, concerning rupture of the wound after cataract extraction. We believe that the majority of such occurrences are due to an increase in intraocular pressure, and by violent contraction of the orbicularis muscle. If the eyeball cannot be compressed easily into the orbit, such contracture will result in a very marked increase in intraocular pressure, which we have proved by introducing into the vitreous a needle connected with a manometer. We then measured the pressure with flaccid lids and again under violent orbicularis contracture.

Finally, the posterior half of the orbit was entirely filled with normal saline, so

that the eyeball could not be compressed into the orbit and the measurements of pressure repeated. The relationship of pressure under the varying conditions was 2-15-23.

We then devised a compressometer to measure the degree of compressibility of the eyeball into the orbit and the degree of force necessary. Within this we are measuring each case before cataract extraction and comparing these measurements with the incidence of postoperative wound rupture.

The answer to the problem is simple; namely, the elimination of the orbicularis from action until such time as the wound is firmly closed. We accomplish this by tenotomy of the superior and inferior portions of the orbicularis through a wide canthotomy.

OCULAR HYPERTELORISM OF GREIG*

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No paper or report can be made on this subject without first mentioning the illustrious work and the exhaustive monogram of David M. Greig,[1] who was the first to give this developmental anomaly its name. In 1924 he so thoroughly described the clinical, pathological, and structural characteristics of a specific type of ocular hypertelorism that no one has criticized nor added much to his contribution, except the report of additional cases. Ocular hypertelorism means "the eyes separated, too much, apart." There is a growing use of this term in conjunction with other cranial deformities, and I should therefore like to make a plea that the deformity under discussion be rightfully designated as "Ocular hypertelorism of Greig."

This entity is a congenital malformation of the skull characterized clinically by an excessive width in the spacing of the orbits, a broad, flat nose with its tip retroussé, and pathologically by an abnormally small size of the greater wings of the sphenoid and an abnormally large size of the lesser wings. As the fetus and then the infant develop, the bony orbits are pushed laterally, producing the wide spacings of the orbits and eyes, a divergence of the orbital axes, with more or less divergent strabismus, loss of binocular fixation, and nystagmus. The abnormality is said to be the result of a maldevelopment commencing in early embryonic life, of that portion of the sphenoid bone that is laid down in cartilage. Ossification occurs early, and the subsequent growth is excessive.

Bojlen and Brems[2] called it an attempt at clefting malformation, as evidenced by several cases with "double nose," that results from an anomalous development of the prosencephalon.

These two authors so exhaustively considered the 42 cases reported in the literature during the period of 1924 to 1938 that a brief review of their work should be included here. Among their own cases, they reported 11 persons with low-grade hypertelorism among 24 members of the same family, extending through five generations.

Of the 42 cases published under the name of ocular hypertelorism, they consider the diagnosis to be erroneous in 14. Only 27 can be said to be fairly certain,

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* From the Clinics of the Children's Memorial Hospital. Read before the Chicago Ophthalmological Society, October 21, 1940.

and among these, the following phenomena can be said to characterize this developmental anomaly:

(1) Intellectual status: 12 patients showed mental defect while 15 were normal.

(2) Physiognomic characteristics: Considerable interorbital breadth; divergence is present; there may be an associated flat nose, broad at the root, with the tip retroussé; the skull cap does not usually show any typical abnormality; the eyelids and brows may be deformed and the palpebral fissure may deviate from the horizontal in either direction; occasionally epicanthus is present, nystagmus, and deformity of the ears.

(3) Disturbance of vision and exophthalmus are both rarely seen.

(4) Associated deformities are not necessary to the picture, but it is quite common to find several congenital malformations in any one individual. The distal parts of the extremities (the fingers and toes) may be short and broad or thin and narrow.

(5) Associated diseases were epilepsy, heart lesion, and connective-tissue dysphasia.

(6) Uncomplicated cases occurred upon eight occasions other than the ones Bojlen and Brems reported.

(7) Roentgenographic character: The only consistent findings were a great breadth between the orbits, a large and quadrilateral apertura pyriformis, short and broad nasal bones, and large lesser wings of the sphenoid.

(8) Familial occurrence: There is considerable evidence of its presence in various members of a family.

Because of the exhaustive treatise of Bojlen and Brems and the desire to make this presentation as short as possible, further considerations will be limited to the presentation of four cases seen at the Children's Memorial Hospital, which it would seem could be classified under Greig's type of hypertelorism.

Case 1. D. W., a female, aged five years, was first seen on February 3, 1938, with a clinical picture of lobar pneumonia. She was desperately ill; her physical condition continued to grow worse, and she died on the evening of February 4, 1938. A post-mortem examination was performed.

She had been a full-term baby, born with normal delivery, breech presentation, weight 7½ pounds. Father and mother are living and well and both appeared to be normal. Four other children all appeared to be normal. There were no known familial deformities nor diseases. The mother fell down two flights of stairs when five months pregnant with this child. At birth multiple congenital anomalies were noted; such as wide spacing of the eyes, unusually broad, flat nose, pigeon breast, feet in extreme valgus position, bilateral congenitally dislocated hips, inequality in the size of the toes of both feet, and all the joints loose in nature. Subsequent growth and development were essentially normal, and the parents considered her mental development as normal. The past history for illnesses was entirely negative.

Physical Examination, including only the pertinent findings, revealed an acutely ill female child. The eyes were spaced widely apart and were separated by an extremely broad, flat nose. The head was almost box shaped, with prominent frontal and parietal bones. The occiput was pointed, and the forehead was broad and perpendicular. The fontanelles were closed. There appeared to be an additional bone in the midline of the nasal ridge, two ridges being palpable over the bridge of the nose. At each inner canthus of the eyes there was a pulsation on the lateral aspects of the flattened nasal bridge and the veins here were unduly prominent.

The eyes were directed anteriorly and moved freely in all directions. There was

no strabismus. The pupils were equal and regular and reacted to light and convergence. The mouth was small but well

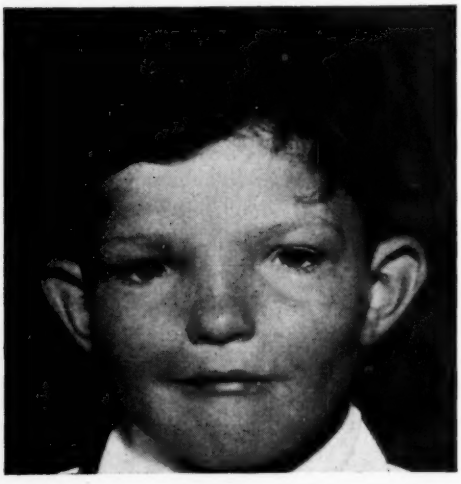

Fig. 1 (Vorisek). D. M. (see case 2) at five years of age.

formed, and the teeth and dental arches did not seem to be abnormal. Marked pigeon-breast deformity of the sternum was observed.

Upper Extremities. Both index fingers were curved toward the ulnar side, both little and ring fingers toward the radial side, and there was definite webbing between the middle and ring fingers. The finger joints were all relaxed; both elbows were deformed, with the movement of supination impossible.

Lower Extremities. Both big toes were unusually short and all the rest of the toes were webbed. Both feet were in extreme varus position and slight equinus. The feet were unusually flexible and the reflexes were all normal.

Wassermann and Kahn tests on post-mortem blood specimen were negative.

Roentgenograph (post mortem). "Views of the skull showed normal-appearing skull tables and sutures. The vertical diameter of the skull is approximately equal to the antero-posterior diameter. No abnormal intracranial calcifications are seen. The digitations in the posterior portion of the cranium are prominent."

Post-mortem. "Well-developed and well-nourished female. The head was quite large, measuring 52 cm. The calvarium

Fig. 2 (Vorisek). D. M. at 11½ years of age.

was opened in the usual manner, and the cut surface of the skull bones revealed the frontal and parietal bones to be approximately twice the thickness of the occipital bone. The brain was markedly edematous and congested, but there was no flattening of its gyri, and the cortical surfaces everywhere appeared to be normal. When the brain was removed no gross abnormalities could be found at the brain stem nor when it was sectioned through the midline. The base of the skull showed apparently normal development except that the lesser wing of the sphenoid bone appeared to be slightly larger than normal and the posterior fossa smaller than normal. The orbital spaces were more shallow than normal. The brain weighed 1,450 grams."

Case 2. D. M., a male, was first seen at the age of 5 years (fig. 1) and again at 11½ years of age (fig. 2). He was a full-term baby, delivery was normal, and he continued to date to develop normally both physically and mentally. He had been a healthy child, with no history of serious illness. He was the only child, and the mother and father were both living and well and both have a normal appearance. There was no known relative with a similar appearance.

Examination revealed a well-nourished boy with eyes spaced far apart. He had a broad, flat nose with distinct epicanthus. He had binocular fixation. There was no heterophoria and no exophthalmus. The pupils reacted normally. The palpebral fissures were very small, the horizontal diameters measuring only 20 mm., giving the appearance of microphthalmus, but both corneae measured 12 mm. in the horizontal diameter. The pupillary distance was 68.5 mm., the intracranthal distance, 53 mm. The unaided vision was R. 20/20; L. 20/100.

Refraction under atropine cycloplegia was R.E. +1.25 D. sph. ⌯ +0.75 D. cyl. ax. 80° = 20/20. L.E. plano ⌯ +5.00 D. cyl. ax. 70° = 20/50. The fundi were lightly pigmented; that of the left eye quite blurred from the astigmatism, but

Fig. 3 (Vorisek). D. M., at same age as in figure 2. Antero-posterior roentgenograph of skull.

otherwise both of the fundi were entirely normal.

The roentgenograph showed dense, normal-appearing bones, sutures, and sella. The nasal opening was wide and the orbits were spaced far apart (fig. 3).

Case 3. J. B., a male, was last seen in our clinic 10 years ago at the age of 12 years. Details of the ocular examination were incomplete and a recent follow-up failed to reveal his present whereabouts. He was first seen at the age of seven years, at which time it was noted that he had a very wide, flat nose and that his eyes were widely separated. He had a right convergent strabismus, a conjunctivitis, and a blepharitis. The pupils were equal and reacted to light and convergence. He had in addition a tuberculous

spine with kyphosis, a pigeon breast, and a partially undescended right testicle. Psychometric examination revealed a retarded mentality. The parents appeared normal, and no familial hereditary traits were noted in the history.

Roentgenographs of the skull revealed a wide base of the nose with widely spaced orbits.

Case 4. J. R., a male, was seen at the age of five years. He displayed a very wide pupillary distance and broad, flat nose. Both corneae were larger than normal and contained striate opacities. Both anterior chambers were very deep. The left disc appeared normal; it was not pale, and there was no evidence of deep cupping. The right disc could not be seen through the small pupil. The vision was R. 20/70; L. 20/70. The father's appearance was entirely normal. One brother was said to have congenital glaucoma. Besides a diagnosis of ocular hypertelorism, a diagnosis of congenital glaucoma was also made. This patient did not return as requested for further study and observation, and a follow-up revealed that he and his brother were both registered at another clinic. Let us hope that these interesting cases will be published in greater detail, although seven years have already elapsed since J. R. was first seen at our clinic.

Summary

Four cases of ocular hypertelorism as described by Greig in 1924 are here presented, none of which has displayed hereditary tendencies. In three of these cases photographs or roentgenographs or both prove the diagnosis, whereas the merits of the fourth case must rest on clinical observation.

104 South Michigan Avenue.

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NOTES, CASES, INSTRUMENTS

CONTACT GLASSES AS AN AID IN STRAIGHTENING THE EYES

REPORT OF A CASE

SOL GOLDBERG, M.D.
Pittsburgh, Pennsylvania

In the management of squint the criterion of success is the straightening of the eyes. This is accomplished by use of one or a combination of the following procedures; namely, orthoptics, glasses, or operation.

Eyes with high hyperopia are frequently made parallel with proper correction but remain parallel only so long as glasses are worn. Many individuals with convergent squint corrected by glasses desire to appear in public without the use of glasses, but the squint then becomes immediately apparent. Contact glasses were employed in such a case with considerable success.

S. L., aged 26 years, was first seen on September 13, 1940. Pertinent findings were:

1. Vision, R.E., 20/100, corrected to 20/30 with +2.00 D. sph. ⊂⊃ +2.50 D. cyl. ax. 105°; L.E., 20/100, corrected to 20/20 with +2.25 D. sph. ⊂⊃ +2.50 D. cyl. ax. 85°.

2. Right convergent squint varying from 30 to 40 degrees without glasses, and 5 to 10 degrees with glasses.

Figures 1 and 2 show the patient with and without the use of contact glasses.

Fig. 1 (Goldberg). Patient wearing no glasses.

Fig. 2 (Goldberg). Patient wearing contact glasses.

I have found no reference in the literature to the use of contact glasses acting as a correcting agent. The procedure offers cosmetic improvement in an undetermined percentage of strabismus cases. The incidence of improvement can be more accurately determined with wider use.

May Building.

A NEW CONTAINER FOR OPHTHALMIC OINTMENTS

WILLIAM J. HARRISON, M.D., F.A.C.S.
Philadelphia

Ophthalmologists the world over have for many years recognized the advantages offered by eye medications in ointment form. It is agreed that an ointment has many advantages over an aqueous solution; first, in that it is not drained off through the lacrimal canal or squeezed out onto the face; second, it is kept in contact with the eye over a longer period of time. However, the many disadvantages to the use of ointments in collapsible metal tubes seemed to outweigh the advantages. The collapsible tube holding the ointment becomes unclean and unsightly after once having been opened. The cap of the tube often is lost and the neck of the tube accumulates contaminated material. The ointments so supplied are not sterile, and one certainly would hesitate to place such ointment in the cul-de-sac of any eye, and especially immediately following surgery.

For home use the collapsible tubes present just as many disadvantages. The little metal nozzles are often quite sharp, and there is constant danger of injury to the eye by administration from unskilled

Fig. 1 (Harrison). Gelatin ointment container in use.

hands. The tubes are frequently kept for some length of time, become leaky, further contaminated, and in themselves a possible source of infection.

With these many faults in mind, a soft gelatin capsule was devised containing sufficient ointment for one application. Its soft gelatin tip can be snipped off easily and, by pressure on the bulb, a ribbon of ointment is expressed. However, much research was necessary to render the gelatin equal to the task of keeping free of stickiness in the hot humid days of summer, and from becoming brittle and hard in cool weather. After experimentation and study, a gelatin was devised containing phenyl mercuric chloride, 1:50,000 which kept the gelatin aseptic; and even after immersion in 70-percent alcohol the capsule retained its pliability. It was also found that this agent in a 1:50,000 strength could be incorporated in the ointment itself without irritation to the eye or untoward results as to the medicament.

Dr. Joseph W. E. Harrisson of LeWall & Harrisson, analytical chemists, carried out tests and found that 1-cm. squares of the gelatin produced no growth when introduced into alcohol of a concentration varying from 50 to 95 percent, allowed to remain for periods of 5, 10, and 15 minutes, and then removed to a nutrient broth and incubated for 72 hours. The same tests had been carried out before, in testing chlorthymol and beta-naphthol in the gelatin mass, but the latter could not be rendered aseptic on immersion in alcohol of any strength when these antiseptics were employed.

Further tests were carried out to determine whether or not the contents of the capsule were sterile in so far as aërobic organisms were concerned. Under sterile conditions the tip of each was snipped off and its contents introduced into a bottle with 20 c.c. of sterile broth and beads. These latter had been previously warmed to 37°C. After agitation, a subsample was removed and transferred to a subculture tube. No growth was obtained in any case either in the direct sampling or the subsampling.

A list of ointments was then manufactured, and in order to distinguish certain formulas containing atropine, these capsules were colored red, which serves to warn the physician of their contents. Other formulas have been dispensed in black capsules to protect them from light. The remaining formulas were put up in uncolored translucent gelatin containers. It is believed that this new type of gelatin container overcomes all of the disadvantages that have hitherto prevented the extensive use of ointments in eye medication.

The McNeil Laboratories of 2900 North 17th Street, Philadelphia, Pennsylvania, have undertaken the manufacture of these capsules of ointments under the name of "Ophthalets," and they may be obtained in boxes containing 30 individual applications.

135 South Seventeenth Street.

ACUTE MYOPIA INDUCED BY SULFANILAMIDE

Report of a case

Bernard B. Friedman, M.D.
Corpus Christi, Texas

One of the most important studies in relation to a drug that has been newly adopted for the treatment of disease is its toxicology. Most of this can be developed experimentally by animal study before its release for human use. However, one phase of such work cannot be so solved, and that is its effect on vision due to its subjective nature.

Several toxic effects of sulfanilamide have been reported in the literature, among them acute myopia induced by its ingestion. Due to the wide application of this drug and its ever-expanding field of therapy, it is felt that any toxic condition that may result from its use should be brought to the attention of all who prescribe it.

Report of a case. T. H., a white male, aged 29 years, caught cold July 11, 1940. On the following day his physician ordered sulfanilamide. He took no medication other than the prescribed 150 grains in the following 20 hours. He came to me on July 15, 1940, with the complaint that his distance vision was considerably blurred. He feared he was going blind.

His past history revealed no similar experience at any time. His general condition had always been good, and he was not in the habit of taking any medication whatsoever.

Examination revealed the following positive findings: The vision for distance was: R.E. 20/80; L.E. 20/100. The near vision was normal. The pupils were slightly larger than normal but reacted promptly to light and accommodation. The fields and tension were within normal limits. There were no evidences of pathological change.

Refraction showed that vision in the R.E. with -1.50 D. sph. $\bigcirc\!\!\!\!-$ $+.75$ D. cyl. ax. 80° was 20/20; in the L.E. with -1.75 D. sph. $\bigcirc\!\!\!\!-$ $+.75$ D. cyl. ax. 90° was 20/20. Homatropine was then instilled and retinoscopy showed the refraction to be approximately the same as given. This eliminated the possibility of a case of spasm of the accommodation.

Two days later on July 17, 1940, when no more sulfanilamide had been taken, the vision was 20/20 in each eye without correction and the acceptance was in the R.E. $+.50$ D. cyl. ax. 90° = 20/20; in the L.E. $+.25$ D. sph. $\bigcirc\!\!\!\!-$ $+.50$ D. cyl. ax. 90° = 20/20. He stated that his vision had returned to normal as well as he was able to appreciate it.

He was last examined on November 7, 1940, when no changes were found from the previous examination. Whether or not a change similar to that which takes place in a case of diabetes resulting in an acute temporary myopia took place here, is a matter of conjecture.

Conclusion. Acute myopia is another of the possible toxic manifestations of the ingestion of a most useful drug, sulfanilamide. The use of medication with less toxic reactions than sulfanilamide may be suggested in the treatment of diseases when sulfanilamide is not specifically indicated.

916 Jones Building.

AMERICAN BOARD OF OPHTHALMOLOGY

CASE REPORT

GARRETT L. SULLIVAN, M.D.
Boston, Massachusetts

FINAL DIAGNOSIS: EMBOLISM OF THE SUPERIOR TEMPORAL RETINAL ARTERY

SUMMARY

A case of embolism of the superior temporal branch of the central retinal artery is presented. Medical and surgical treatment is described. No improvement was obtained.

Present History

W. F., a 28-year-old, single, white man, presented himself at my office on April 3, 1940, for the first time. He complained of a blur in the lower field of vision, O.D., of 40 hours' duration. He stated that two nights before, while refereeing a basketball game, he suddenly was aware of blurring of the lower portion of the field of vision, in the right eye, toward the nose. No change had been noted since that time. No blurring of vision, O.S., had been noted. Because of the persistence of the blur he came for examination. There had been no pain nor redness of the right eye. His general health had been good. There had been no recent illnesses, such as cold or sore throat. There was no history of trauma to the eye.

Previous History

His eyesight had always been good. He did not wear glasses and had never had any trouble referable to the eyes before. General health had always been good. There was no history of rheumatic fever, growing pains, chorea, or St. Vitus's dance.

Family History

Irrelevant.

Physical Examination

The patient was a well-developed, well-nourished, healthy young man. The skin and mucous membranes were clear, of good color, and exhibited no petechiae nor purpuric spots. The heart was normal in size, rate, and rhythm. No murmurs were heard. The blood pressure = 130/70. The lungs were clear to auscultation and percussion. No rales were heard. The abdomen showed no palpable masses nor tenderness. The extremities showed no edema. No varicose veins were present. Reflexes were normal. The radial pulse was 70, of regular rhythm.

Laboratory

Examination of the urine showed no albumin or sugar, presumptive evidence that there was no diabetes nor nephritis present.

Eye Examination

Vision: O.D. = 20/15 without correction; O.S. = 20/15 without correction; O.U. were straight with good ocular excursions in all directions. Convergence power was good, the near point of convergence being 6 cm.

The lids showed no abnormalities.

Examination with the flashlight, slit-lamp, and ophthalmoscope showed the conjunctivae to be clear with no inflammation. The palpebral conjunctivae were of a normal pinkish-red color.

There was no inflammation of the sclerae. The corneae showed no pathological changes.

The anterior chambers were normal in depth and showed no cells nor opacities. The pupils were small, round, regular, and equal, and reacted well to light and accommodation. There was also good reaction to indirect light. The irides exhibited no pathological changes.

The lens and vitreous of each eye were clear.

The fundus of O.D. showed an optic

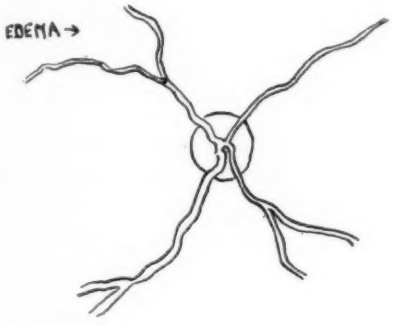


Fig. 1 (Sullivan). Embolism of the superior temporal retinal artery.

disc of normal pinkish color with good centrally located physiological cupping. The disc margins were clear-cut. There was no elevation of the disc.

The branches of the central retinal artery were followed in their retinal course as far as possible and all were normal with the exception of the superior temporal branch. At a point about one disc diameter away from the optic disc the superior temporal branch bifurcated and at this point the branches became markedly attenuated, being about one third to one half the caliber of the vessel at the disc. In addition, the vessels beyond the point of division were seen through a whitish haze that extended along the course of the two vessels, out into the superior temporal quadrant of the retina. No hemorrhages were seen. At the bifurcation there was a small point of increased redness.

The field of vision showed constriction of the nasal field (fig. 2). The vessels throughout the rest of the fundus showed no caliber changes, dilatation, or tortuosity, increased light reflex, or abnormal arteriovenous nicking.

The fundus examination of O.S. showed no pathological changes in the optic disc, vessels, or retina. Examination of the fundi was facilitated by the use of a mydriatic.*

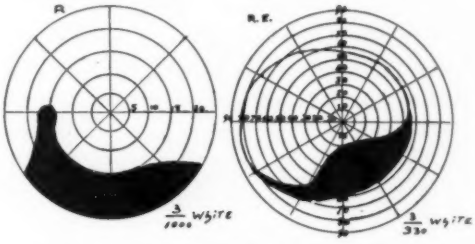


Fig. 2 (Sullivan). Visual field O.D. constricted nasally. The field O.S. was normal to the same size of visual angle.

The field of vision O.S. was normal.

Diagnosis: Embolism of the superior temporal retinal artery.

Consultation

Dr. J. Herbert Waite concurred in the diagnosis and advised paracentesis and the use of vasodilators.

The patient was immediately referred to the Massachusetts Eye and Ear Infirmary for paracentesis. It was also decided to use 20-percent mecholyl† retro-

* The mydriatic used was the following solution:

Cocainae hydrochloridi, gr. iiss
Eucatropinae hydrochloride, gr. iiss
Chlorbutanolis, gr. ss
Aq. dest., ad., 3 ii

One drop was placed in the right eye every three minutes for four doses; after 10 to 15 minutes the pupil was widely dilated.

† Mecholyl is Merck's trade name for betamethyl chloride acetyl choline. This drug is the most powerful vaso-dilator that could be used. It might also be added that atropine sulphate gr. 0.01 was ready for use if necessary, as it is a direct antagonist to mecholyl in its physiological action.

bulbarly as the vasodilating agent. In this connection, and because of the use of mecholyl, a close inquiry was made into the past history for any signs or symptoms suggestive of hay fever or asthma. The reason for this is that one of the actions of mecholyl is to cause a constriction of smooth muscle and hence it would be a dangerous agent to use in an asthmatic subject. This action also explains the diarrhea that may accompany the use of strong doses of mecholyl. History of such diseases was negative and the patient was considered a good subject.

Nembutal 1½ gr. was given preoperatively.

Operation

Paracentesis was performed and immediately afterwards 0.1 c.c. of 20-percent mecholyl was injected retrobulbarly. The patient promptly became markedly flushed and began to perspire profusely. The blood pressure became elevated to 180/100. This reaction lasted for 15 to 20 minutes and then began to subside. The blood pressure gradually fell to 140/80 after a half hour. During this time an examination of the fundus O.D. with the ophthalmoscope showed no change. Atropine ointment, 1 percent, was instilled O.D. A single eye tie was applied over the eye and the patient was sent from the operating room in good condition. Nembutal 1½ gr. was given for sleep.

The following morning examination of the eye showed no change. The field of vision also showed no change (see fig. 2).

On April 4, 1940, the patient was discharged.

Discharge medication:

℞ Zinci sulphatis, gr. 0.5
Acidi borici, gr. X
Aq. dest., ad., ℥ j.
Sig., gtt., j, t.i.d., O.D.

Arrangements were made for the patient to consult his own family physician for a thorough check-up and also to have a check of his teeth by his own dentist.

He was seen by me on April 18, 1940, at which time there was no change in the condition. He stated that he had had an abscessed right upper bicuspid tooth removed and otherwise his teeth were reported to be in good condition.

Discussion

It was of interest that the patient noted the blur in his binocular peripheral field of vision. Before the examination of the eye the first possibility seemed to be a separation of the retina, for this would probably be the most common cause of such sudden blurring of vision. On examination, however, there seemed to be no question of the diagnosis, except that the condition might be due to spasm. However, the persistence of the caliber changes of the vessels, together with the reddish spot suggestive of an embolus, pointed to the diagnosis made. Treatment of such a serious condition, to be effective at all, must be instituted early, within a few hours after onset. For this reason it was thought rather hopeless to operate, but the bare chance of moving the embolus farther away justified the treatment instituted. The complete lack of clues indicating where the embolus might have arisen was mystifying. The abscessed tooth would not seem to be sufficient cause.

The most common cause of emboli in a person of this age is rheumatic heart disease with auricular fibrillation. This patient showed no evidence of such disease.

5 Bay State Road

SOCIETY PROCEEDINGS

Edited by Dr. Ralph H. Miller

SAINT LOUIS OPHTHALMIC SOCIETY

March 22, 1940

Dr. J. F. Hardesty, *president*

Corneal resection

Dr. William M. James said that the surgical removal of corneal scars has been advocated for many years. Numerous cases are reported in the literature, showing visual improvement following the surgical removal of scarred corneal tissue. The operative technique, as advocated by Dr. Meyer Wiener, is difficult because the scar tissue may destroy the natural cleavage planes of the corneal stroma and may obscure anterior synechiae that mark the site of former perforations.

The infiltration of the cornea with air, using a 2-c.c. syringe and a no.-27 hypodermic needle, brings into relief the areas of dense scarring and separates the normal cleavage planes of the substantia propria. The thickness of the cornea may be increased two to four times by the injected air. These factors greatly facilitate the resection of the corneal tissue.

A series of six cases was reported and discussed. Visual improvement was as follows:

Case	Vision Before Operation	After Operation
1	O.D. = L.P.	O.D. = 15/60
	O.S. = HM at 6 inches	O.S. = 5/200
2	O.D. = HM at 1 foot	O.D. = 3/100
	O.S. = HM at 1 foot	O.S. = 3/200
3	O.S. = L.P.	O.S. = F at 1 foot
4	O.S. = L.P.	O.S. = L.P.
5	O.D. = HM at 1 foot	O.D. = HM at 6 feet

The procedure is less hazardous than full-thickness keratoplasty and offers hope of definite visual improvement to a large number of patients. In case 2, one of advanced epithelial dystrophy, there was relief from pain, which had been unremitting for the preceding three years.

Discussion. Dr. B. Y. Alvis said that he had observed many cases in which Dr. Wiener had performed a resection over a period of several years. There are two distinct groups, one of which offers hope of very good vision; the other offers hope of some moderate improvement. Cases in which there is a fairly healthy cornea will generally show marked improvement if the scar tissue is confined to the anterior sections of the cornea. If one has to penetrate to Descemet's membrane, the cornea will bulge and the iris push itself forward, so that the result will not be very good. If there is a small pinhole perforation of Descemet's membrane, an anterior synechia, or even staphyloma, a Descemetocele will retract and scar over if the eye is kept closed and treated with trichloracetic acid or adrenalin solution. Dr. Alvis believes that Dr. James's air-injection method may be of value. The experience that Dr. James has reported parallels very well the experiences of others who have performed corneal resections; that is, if some good cornea remains, there is a fair chance of improving vision; but if the cornea is deeply scarred or vascularized, there is very little hope of improving the eye by corneal resection. To illustrate, he mentioned two cases. In one of them the scar was confined to the anterior layers of the cornea. In the second case there was deep scarring with vascularity, and, after resection, the remaining layers were still opaque; after transplantation, the graft became

vascular. The first case occurred in a man, aged 35 years, whom he had seen in September, 1920. The patient had suffered a burn by explosion of carbide in 1915. The eyes were very sore for a year, during which he was treated by an oculist. At the time Drs. Alvis and Wiener saw him he could see just about enough to get around in places with which he was familiar. His face was also markedly burned. The conjunctiva was red; there was no scarring. The cornea of the right eye was clear; the scar covered almost the entire central portion. The iris could be seen through the less dense portions of the cornea. The pupil was barely visible; numerous vessels were present. Vision, R.E. = 4/200; L.E. = 1/300. Corneal resection was performed in 1920. The patient was last seen in September, 1924. At that time vision, R.E. was 15/200; L.E., 15/40. This was one of the unusual cases in which a reasonably good result came about. The other case was that of a man of 32 years, who had been burned by tear gas in April, 1934. When seen in September, 1934, his cornea was scarred. There was edema of the corneal epithelium and faint infiltration near Descemet's membrane. Vision at that time was: R.E., 1/300; L.E., 4/300. This man had a corneal resection performed. The eyes became quiet, but the final vision was practically the same as before the operation. He has learned that the patient has since gone to New York and Dr. Castroviejo has performed a keratoplasty with about the same result. Dr. James is to be congratulated for the improved technique of corneal resection. Also for calling our attention again to the fact that corneal resection does have a definite place in corneal surgery.

Dr. John Green said Dr. James made reference to the value of corneal resection in vesicular keratitis. The investigation of Dr. Thomas D. Allen, of Chicago, indicates that bullous keratitis is invariably associated with diseased Bowman's membrane. If one resects the cornea, making the dissection deep enough to include all of Bowman's membrane, an epithelial sheet soon covers the remaining stroma and bullae do not recur. A conspicuous and gratifying feature is the prompt relief of pain following the operation. It is also feasible, in the case of an isolated bulla or of bullae limited to one part of the cornea, to confine the operation to the affected portion.

For the past two years he has been working on a patient, a filling-station attendant, who was assaulted by bandits who dashed gasoline into his eyes. Half blinded, he wiped his eyes with a rag assumed to be dry but which actually was wet with battery fluid. After three months in a hospital he was awarded a blind pension. When he first saw the patient both corneae were completely covered with a thick highly vascularized tissue. Vision, R.E., counts fingers at 1 foot; L.E., light projection. The cornea of the right eye was resected, with vision improved to 1/80. Dissection of the cornea of the left eye revealed great thinning and a prolapse of the iris, which had to be covered with a conjunctival flap.

As the left eye is hopelessly blind, he has considered a keratoplasty for the right. However, the cornea is still vascular (though clear enough to enable one to see the texture of the iris) and the pupil is mobile. Dr. James was kind enough to see this patient with him and suggested that as there was still considerable thickness to the cornea another resection offered more chance of visual improvement than a transplant.

Dr. M. H. Post mentioned that Dr. James had said he thought he could control the depth of the air injection in the

cornea. In the photomicrograph the injections went almost to Descemet's membrane. It is hard to believe one can go so close to Descemet's membrane and still maintain a cornea that has much usefulness. It seems the cornea would become flaccid and change shape.

Repair of the canaliculus

Dr. Frederick O. Schwartz said that some time before the patient, a woman of 40 years, had consulted him, a rhinologist made a diagnosis of tear-duct involvement while he was treating her nose, and along with other measures slit the canaliculus of the left lower eyelid, and passed probes several times into her nose.

When she came to Dr. Schwartz she had a chronic conjunctivitis and a slight epiphora which caused her some inconvenience. There was a constant accumulation of moisture at the inner canthus.

No definite bacterial nor other agents were determined to be the cause of her trouble, and he believed that the malposition of the lower-lid border played a very important part as an etiologic factor. The punctum was entirely gone, the canaliculus was slit for 5 millimeters, and the margin of the eyelid was everted for fully one third of its length.

Under local 2-percent novocaine anesthesia, the tissue which had covered over the wounded surfaces of the original incision was dissected away very carefully, above and below, by means of a cataract knife and the aid of a Zeiss binocular magnifier.

Next, two sutures of very fine silk threaded on very thin full-curved needles were passed through that portion of the lid between the canaliculus and the conjunctival surface.

A piece of fine gold wire, 1¼ inches long, had been prepared previously. A small loop was turned at one end, and the wire was bent about one-fourth inch backwards and parallel to the longer part. A double length of silk was tied in the loop.

The straight end of the wire was passed into the canaliculus and farther into the sac (fig. 1).

Fig. 1 (Schwartz). Slit canaliculus with gold wire inserted. Two sutures ready for tying have been passed from the conjunctival surface through the denuded canal coverings on both sides. The wire is held in place by a silk thread.

The two sutures were tied, and the free ends of the silk fastened in the loop were attached to the side of the nose with adhesive to prevent slipping.

After four days the two sutures sloughed out, but the wire was permitted to remain in its original position for a total of 10 days, when communication had been reëstablished and the malposition of the lid corrected. The conjunctivitis disappeared.

The effects of malpositions of the eyelids in the production of external ocular irritations are common and are frequently the cause of a number of results attributed to obscure or undiagnosed factors. It is well to consider in such cases not only the malposition but also the reasons for their presence in an effort to gain a more intelligent appraisal of cause and effect.

The promiscuous slitting of the cana-

liculus especially by untrained or unskilled operators should be discouraged.

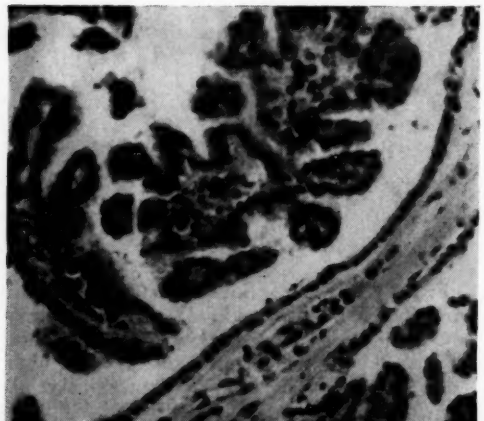
Ocular findings in a patient 10 years after removal of a subtentorial tumor

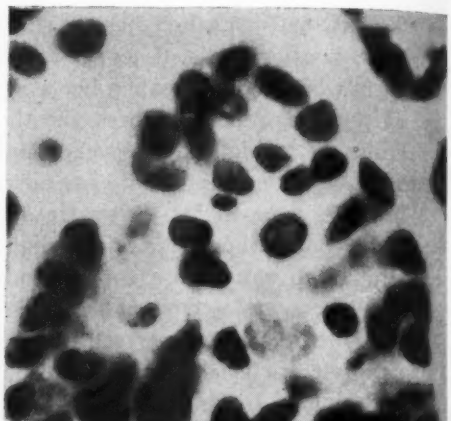
Dr. Carl T. Eber said the patient had entered the hospital on November 8, 1939, because of a sudden "seizure" on the previous evening. His entire body had become rigid for several minutes and this was followed by grogginess, slow, difficult speech, failing vision, weakness, and amnesia for about 24 hours. Walking had become more and more difficult and speech slower for some months prior to this attack. He did not complain of headaches, nausea, or vomiting.

Physical examination revealed depressed mentation, slow, slurring speech, suppressed face, deflection of the tongue to the right, stereognosis, and bilateral pathologic toe signs. Finger-to-nose and hand-to-shin tests were very uncertain and inaccurate. Generalized muscle weakness was present, and he was unable to void.

Examination of the eyes showed bilateral sixth-nerve paresis. The pupil of the right eye reacted to light, but that of the left eye was immobile. Both optic discs were markedly choked, the right being elevated about four diopters and the left about six diopters.

The urine and differential blood count were normal. Red blood cell count was 4,700,000; white blood cell count was 16,300. Hemoglobin content was 85 per-





Figs. 1 and 2 (Eber). Subtentorial tumor tissue.

cent and non-protein-nitrogen was 39. Blood sugar was 116.

On November 8, 1939, by ventricular puncture, clear cerebrospinal fluid was obtained under increased pressure, with no increased globulin, and w.b.c. of 103.

Dr. W. T. Coughlin performed a craniotomy on November 9th, and found an inoperable tumor extending downward from the fourth ventricle. The patient died a few minutes after the close of the operation.

Gross findings at autopsy were as follows: Yellow, flat masses, firm to the touch, were scattered the full length of the cord from medulla to cauda equina. Tumor masses, thickened dura, and adhesions were observed on all surfaces of

the medulla and posterior cerebellum. On the anterior surface of the medulla were four or five oval, hard masses. The dura was adherent to the skull at the site of the previous operation. Cut sections of the masses had a light-yellow color, with only slight differentiation in color from the rest of the brain.

The body cavities were negative. The tricuspid ring was somewhat dilated and the lungs showed some atelectasis. The omentum was normal, but engorged; firm lymph glands were found between the duodenum and the common bile duct. The gastro-intestinal tract, the spleen, liver, gallbladder, pancreas, and kidneys appeared to be normal.

Microscopic findings of sections (figs. 1 and 2) from small papillary growths along the spinal cord and from the original growth in the fourth ventrical showed thin columnar cells growing in papillary formation on moderately thick connective-tissue stalks. The larger papillary processes showed good-sized blood vessels in the center of the stalk. Very few mitotic figures were seen. The heart, lungs, and lymph glands showed no evidence of invasion.

Adolph Lange,
Editor.

CHICAGO OPHTHALMOLOGICAL SOCIETY

April 15, 1940

DR. EARLE B. FOWLER, *president*

CLINICAL MEETING

SURGICAL REPAIR OF TRAUMATIC IRIDODIALYSIS: WHEELER'S METHOD

DR. STERNES said that J. H., a white boy, aged 10 years, entered the hospital on June 22, 1939, shortly after receiving a severe contusion injury to the left eye due to the discharge of an explosive toy. There was a nasalward dislocation of the lens, and an extensive iridodialysis throughout three quadrants, the iris root remaining intact only between 7- and 9-o'clock positions. The lower part of the anterior chamber contained the detached iris and a 3-mm. hyphema. There was diffuse clouding of the cornea, and considerable subconjunctival ecchymosis of the nasal half of the bulb. The vision was reduced to light perception. The right eye was normal, and had no defect of vision.

About five months after the injury (December 1, 1939) a surgical procedure was done to secure reattachment of the iris. A keratome incision was made through the limbus at the 12-o'clock position under a conjunctival flap 5 mm. wide, after placing a black silk suture in the sclera 2 mm. from the limbus and parallel to it. The iris was grasped and drawn out with Gifford's toothed forceps. The suture was passed through the periphery of the iris at the correct point, then tied, and the conjunctival incision closed by suture. The same procedure was done at the 5-o'clock position so as to give the iris root two zones of attachment.

About three months later a discission of the membranous lens remnant was done with a final corrected vision of 0.1.

OBSTRUCTION OF THE CENTRAL ARTERY OF THE RETINA

DR. STERNES present A. K., a negro woman, aged 54 years, who entered the hospital 12 hours after first noting loss of vision of the right eye. Ophthalmoscopic examination of this eye, which was devoid of even light perception, showed marked pallor of the disc, extreme contraction of the retinal arteries, and a cherry red spot at the fovea, surrounding which there was a well-marked grayish-white pallor of the retina. There was marked retinal arteriosclerosis in the

other eye also, and the systemic blood pressure was 220/110.

There was no recovery or improvement of vision despite the use of amyl nitrite within 9 hours, and paracentesis of the anterior chamber within 12 hours following the apparent onset. Hence the obstruction would appear to have been due to an obliterative endarteritis.

Surgical repair of cicatricial ectropion: Wheeler's method

Dr. Sternes said that E. C., a negro, aged 23 years, entered the hospital with a cicatricial ectropion of the left lower lid, which followed an incised wound eight months before admission. There was a linear scar of both the upper and lower lids, with notching of each lid margin, and the ectropion was associated with a dense scar extending for 5 cm. from the lower lid down the left malar region.

The Wheeler technique was applied in this case so that excision of the scar tissue left a triangular defect of each lid, extending into each lid margin and devoid of skin. A full-thickness skin graft from the right upper lid was used to repair the defects. Blepharoplastic procedures were then performed on each side of the grafts in order to unite the upper and lower lids of the left eye by intermarginal adhesions, which will remain for two to three months before being freed.

The Jameson operation for epiphora

Dr. Sternes said that G. M., a negro, aged 24 years, entered the hospital for relief of epiphora which had continued after extirpation of the right lacrimal sac in 1935. On January 14, 1940, the operative procedure of Jameson was performed on this patient. It consisted essentially of severing the lacrimal ducts subconjunctivally. Through a linear conjunctival incision just below the outer canthus, the retrotarsal conjunctiva, from the upper edge of the tarsus to the bulb, along the temporal two thirds, was dissected free from the underlying tissues. Stevens' scissors were used, and the dissection made in a very superficial plane so that the blunt scissor points were seen through the thin conjunctiva. The exposed lacrimal ducts were then severed.

The postoperative course was characterized by a swelling of the soft tissues of the adjoining malar and temporal regions, which lasted about two weeks. A period of about six months usually elapses after this procedure before its full effect in relieving the epiphora occurs.

Pseudomelanoma of iris

Dr. Bertha Klien presented a paper on this subject which has been published in this Journal (February, 1941).

Spherophakia with glaucoma and brachydactyly

Dr. Samuel J. Meyer and Dr. Theodore Holstein read a paper on this subject which has been published in this Journal (March, 1941).

Discussion. Dr. Theo. M. Shapira said that the usual question in the case of microphakia is why we get a glaucoma. Dr. Meyer explained correctly that the lens bulges into the anterior chamber and interferes with normal circulation of the aqueous. Urbanek's case was a glaucoma that he incorrectly reported as due to abnormally large lenses. He called it inverse juvenile glaucoma. The case was first seen in 1929 at Elschnig's clinic, and the patient was refracted, given glasses, and allowed to leave the clinic. Four years later she appeared at the Meller clinic, and Urbanek made his diagnosis. He did not remove the lens. A year later the patient was seen at Elschnig's clinic with bilateral glaucoma. She was then about 11 years of age. The slitlamp showed a small lens, and as there had been several cases re-

ported from the clinic before this time the assistants were on the alert. The refraction was −17.0 D.sph. without any fundus change and normal corneal curvature. The lens was weighed after removal and weighed 0.14 gram; the usual normal weight is 0.2 gram. After extracting the lens the patient took a correction of +10.00 D.sph. ⌯ +5.00 D.cyl. which would speak for a normal size of the bulb. Since there was no fundus pathology such as is usually present in myopia gravis, and since the lens was definitely measured and weighed and found to be microphakic, the glaucoma (as reported by Urbanek) was not due to an abnormally large lens, but, on the contrary, to an abnormally small lens.

OPTIC CHIASMAL ARACHNOIDITIS (LUETIC)

DR. CARL SCHAUB read a paper on this subject.

Discussion. Dr. Harold Voris said that he was unable to add anything to what Dr. Schaub has said concerning the diagnosis of this condition or the indications for surgical interference. A few words might be said concerning operative technique. From the standpoint of intracranial surgery this operation is relatively simple. The approach is one that has become quite standardized in most neurosurgical clinics for approach to the anterior fossa and especially for lesions about the sella turcica. The so-called transfrontal approach suggested by Naffziger is usually used. The incision is made in the mid-line of the forehead, about 2 to 3 cm., and extends below the hair line posteriorly and then inferiorly to end just above the ear. The skin flap is reflected anteriorly, and a small osteoplastic flap, as low-lying as the frontal sinus will permit, is reflected laterally. From then on the approach is extradural as far down as the sphenoid ridge; the rest of the exposure is completed within the dura—or the entire approach may be intradural. The side of approach is immaterial. Most surgeons confronted with the problem of a tumor will approach on the side on which the vision is most affected. Certainly, in cases of this type, it is correct for the right-handed surgeon to approach on the right side. The mortality of such a procedure should be considered, especially since it is an elective operation. The mortality of such a procedure in the type of case referred to, without intracranial pressure, should not exceed 2 percent. If it does, there is probably something wrong with the selection of cases. It is quite different from intracranial surgery in many other conditions, but from the standpoint of the surgical problem involved, it is relatively simple. As Dr. Schaub mentioned, the pathology is almost always generalized. Certainly in the patient operated on a marked leptomeningitis over the entire part of the hemisphere had been observed. This syndrome is really part of a generalized syndrome, long known under various names, perhaps the most popular being pseudotumors. Some have been syphilitic in origin, some nonsyphilitic; many with increased pressure have papilledema. These two patients did not have that, but the appearance of leptomeninges over the hemisphere is the same whether or not papilledema is present. He had had cases in which a decompression was done because of the papilledema, which could not be controlled by conservative means, and had removed specimens of arachnoid from other places in cases of chronic arachnoiditis—from the spine or from the hemisphere—and in most cases the microscopic changes were nonspecific, whether the case was syphilitic or not.

Dr. Frank Brawley mentioned a case in which the diagnostic findings were very similar to those reported here. The operation was done by Dr. Oldberg at St.

Luke's Hospital. It should be emphasized that although, as Dr. Voris says, it may be a simple operation, in this case the arachnoid membrane was so extensive that the bands of adhesions extended into the optic canal, and in stripping the adhesions off the chiasm and the optic nerve on the left side—the nerve was a flat band from constriction—a misfortune occurred, and the central artery of the optic nerve was torn away. Stopping the hemorrhage presented a vast surgical problem. Of course the eye became blind.

Robert von der Heydt.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section of Ophthalmology

April 18, 1940

Dr. Francis Heed Adler, *chairman*

Hand-Schüller-Christian syndrome

Dr. Eunice Stockwell reported such a case in which she gave a short historical and pathological review of Hand-Schüller-Christian's syndrome. Emphasis was placed on lipid disturbance, skeletal disturbance as shown by X-ray study, exophthalmos with concomitant eye changes, and diabetes insipidus.

A 3½-year-old white boy was well for the first 18 months of his life, except for a feeding problem in his early weeks. At the age of 18 months the child had whooping cough from which he never fully recovered. He became emaciated, sickly, and irritable. During that same winter, yellow crusty lesions developed on his scalp which improved only after X-ray therapy. His gums became swollen, spongy, and tender, and his teeth were loosened in their sockets, many being lifted out. During this same period, a yellow viscid discharge developed in his left ear, and it is believed he has been deaf since that time. Following this, diabetes insipidus developed and has continued up to the present. He has had continuous enlargement of the skull with rarefaction. Exophthalmos began and progressed until at the present time the child is unable to close his eyes, and so has developed an exposure keratitis.

The condition has progressed with little improvement from X-ray therapy. Other treatment has consisted of general supportive measures. The prognosis was poor.

Discussion. Dr. Joseph Stokes said that Dr. Fewell and Dr. Stockwell knew a great deal more about this situation than he did. It was of interest that Dr. Stockwell mentioned Dr. Alfred Hand, of Philadelphia, who first described this condition. It was in 1891, before the Pathological Society, that he presented his first observations of a case at the Children's Hospital. The pathologist had said that it was a case of tuberculosis, but Dr. Hand stated that he felt it was not tuberculosis, but a disease not as yet described. The X-ray picture was described by Schüller in 1916, and Christian collected a large group of cases in 1919, describing particularly the pituitary signs and symptoms. Rowland, perhaps more than any one else, beginning in 1928, has given us studies which have shown the disease to be one probably of lipid metabolism. No very great contributions have been made to my knowledge, said Dr. Stokes, since his earlier work, nor has the true etiology been determined. It had, as one could readily see, prominent manifestations including chiefly the bones of the skull and pelvis. Many of the patients, too, showed a marked dwarfism; it was fortunate also that many were self-limited. Although these individuals remained dwarfed, they had no serious mental defect, and physically, except for their dwarfism, they were in good condition.

It was hoped that by means of the X-ray treatment of the child under discussion there would be a regression in the symptoms, but as Dr. Stockwell had said, even with 200 r. there had not been great change. Pituitary therapy had been tried as far as the dwarfism was concerned without much success.

Dr. Mary Buchanan asked whether such patients lived long, or if they died soon.

Dr. Warren Reese asked if there were any explanation for the exophthalmos.

Dr. Francis Heed Adler asked if Dr. Stokes meant by regression that the exophthalmos receded. Did these children ever recover from their disease? In this instance, the exophthalmos seemed to be of the malignant type, and if the child were going to live, something might have to be done to preserve the eyes. Would it, he asked, be advisable to consider decompressing one of the orbits?

Dr. Stockwell answered Dr. Buchanan by saying that these patients usually died as a result of starvation and anemia. The exophthalmos was caused by the decomposition of the fatty substances in the orbit. He thought one could remove the eye but without bettering all the other conditions for which you would have to account. By regression he meant that the child did not live very long.

Dr. Francis Heed Adler said he understood from Dr. Stokes that sometimes the disease stops and the children get well.

Dr. Joseph Stokes answered that many of the patients he had known regressed. Few degrees of exophthalmos, as serious as this, have been reported. He had seen a number of patients but none with such a degree of exophthalmos. The danger of the decompression was that when one opens the lesions they may become secondarily infected, and drain for months. He had seen an instance in which there had been a draining sinus from the pelvis remaining over a period of months. There was great danger in any operative procedure, although something might have to be done in this situation. He asked whether any one present had seen exophthalmos of this degree, because he believed it was comparatively rare. Probably only the more severe cases have been reported in the literature, since he had seen mild cases which were not progressive and which had not been recorded.

Dr. Laurence Weinberger said it was possible also to take off the roof of the orbit for any form of exophthalmos. However, in xanthomatosis, the orbits themselves were filled with granulomatous liquid masses that continued to expand in size and to infiltrate the surrounding bone, so that even though one did remove it, it would be only a question of time until the further accumulation of these masses had made the situation much as it would have been before.

Primary pituitary adenomata

Dr. Laurence Weinberger read a paper on this subject.

Discussion. Dr. Francis Heed Adler said that it seemed a long way from the days when the diagnosis of brain tumors was made on the basis of the patient's having headaches, vomiting without nausea, and choked disc. The more that was seen and learned about brain tumors, the more obvious it had become that they might give rise to any symptoms whatsoever relating to intracranial pathology. He thought if any of the doctors present were faced with some of these histories, especially those of sudden pain in an eye with proptosis and ptosis, the last thing thought of would be pituitary adenomata. Aneurysms would probably come first to the mind. He thought the paper very instructive, even though these pituitary cases were unusual. Although still adherring to the old textbook pictures doc-

tors must keep in mind the fact that pituitary lesions could cause symptoms which were somewhat afield from the site from which the tumor grew.

Dr. McAndrews asked how to explain the onset of sudden pain and whether or not it was due to the thrombosis of the cavernous sinus. He had a patient, whom Dr. Grant had seen, who has a pituitary lesion. She had no complaints at all, no headaches, though a gradual loss of fields was found. She confirmed what had been said, that the patient does not have any of the typical symptoms.

Dr. Shipman asked how to explain the sudden onset of pain if the tumor had been pressing on the trigeminal for so long. He asked, too, in how many of these 169 cases was papilledema found?

Dr. Weinberger responded that Dr. Grant could not be present to discuss the surgical treatment of these cases of pituitary adenoma, in which he is an expert. He pointed out that it was commonly agreed that pituitary tumors, when approached by transfrontal routes, were always approached from the right side because it was easier for the right-handed operator, and avoided the left-handed approach. In some cases it might be necessary to resect the frontal lobe. When one was dealing with a tumor of this nature, extending laterally and pervading the cavernous sinus, it was probably best to forego this general rule and to approach the region from whichever side the oculomotor symptoms were present. These tumors should not be allowed to grow too long. The X-ray treatment should be given early, and should be reviewed in the light of certain signs, that when the tumors do escape the sella and overrun the region of the sella, then surgical procedures became difficult from the point of view of postoperative mortality. Why these patients have sudden onset of pain, he confessed, was just as unknown as why they had the sudden onset of ptosis, or ophthalmoplegia. The suddenness made one conjure up some vision of the tumors rupturing into the cavernous sinus, but this seemed rather unlikely. There must be something going on within the cavernous sinus to which neither postoperative nor post-mortem studies give us clues.

Dr. Adler asked if Dr. Weinberger could give any explanation of the papilledema mentioned in these cases.

Dr. Weinberger said he could not answer that question although he had wondered about it. Papilledema in the series of cases was not particularly rare. He thought that in the earlier group of cases, from 1910 to 1920, it was more frequent than in the later groups, because the early patients were allowed to go longer with a tumor. Altogether they had had 15 or 16 cases of papilledema, varying from slight to 6 or 8 D. It was interesting to note that Cushing and Walker years ago pointed out that 20 percent of the pituitary adenomatas they saw did not have visual symptoms of any kind. Ophthalmologists should keep this point in mind, for one does not necessarily need evidence of injury to the chiasm to make the diagnosis, and if one waits for it, perhaps one waits too long.

Congenital coloboma of the lower lid

Dr. Edmund B. Spaeth presented a paper on this subject which was published in this Journal (February, 1941.)

Warren S. Reese,
Clerk.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

April 16, 1940

DR. WILLIAM D. ROWLAND, *presiding*

THE PRESENT STATUS OF CONTACT GLASSES

DR. JULIAN F. CHISHOLM, JR., read a paper on this subject.

THE ORIGIN, DIAGNOSIS, AND TREATMENT OF PITUITARY-BODY TUMORS

DR. OSCAR HIRSCH explained, on the basis of embryology and histology, the development of tumors of the anterior lobe of the pituitary gland. He said that the tumors of the posterior lobe are usually metastatic. From the pathologic standpoint, tumors may be classed as follows: adenoma, adenocarcinoma, craniopharyngioma, tumors of pregnancy cells, notochordoma, chondroma, meningioma (endothelioma), osteoma, teratoma, dermoid, sarcoma, aneurysma, xanthoma (as part of a general xanthomatosis), tuberculous, and gumma. Dr. Hirsch divided all these tumors from a surgical standpoint into four groups: suprasellar, intrasellar, intracranial, and cystic tumors. New growths developing in the spongy body of the sphenoid and those growing in the lateral direction are a great rarity. The suprasellar tumors are approachable by transcranial methods only; for all others, Dr. Hirsch's endonasal method is applicable, the cystic tumors being especially easily operable by this method.

It is therefore important to know beforehand to which of these groups a pituitary-body tumor belongs. The speaker gave a symptomatology based on the ocular, X-ray, and body findings. In a small number of cases the clinical symptoms are not sufficient; it is then necessary to use encephalography.

Treatment is nonoperative (by X ray or radium) or operative. X-ray treatment presupposes a solid tumor, but 17 percent of these new growths are cystic. According to Hare and Dyke, who followed up 63 cases over a period of eight years, improvement occurred in chromophobe tumors in 26 percent; in 47 percent the condition became worse; among acidophil tumors 40 percent were improved, and 24 percent became worse. Previously unsuccessful X-ray treatment produces difficulties when the transfrontal method, not when the endonasal method, is used. A trial of X-ray treatment can be agreed upon if there is a history of slowly diminishing vision.

For operative treatment two methods are available: the transfrontal method of Krause, perfected by the neurosurgeons of the U. S. Army, and especially by Cushing; and the transsphenoid method, performed according to Cushing in 1912, and according to Hirsch in 1910. Hirsch used local anesthesia and the submucous resection of the nasal septum from an endonasal incision; Cushing, general anesthesia and the sublabial incision. Cushing operated by transsphenoidal method in 227 cases, and by transfrontal method in 101 cases from 1913 to 1932. The follow-up of Cushing's cases was made by Henderson of Leeds, England. Hirsch operated, from 1919 to 1937, by the endonasal approach in 277 cases. The mortality rate was about the same for all methods, approximately 5 percent. Larger tumors can be removed entirely by neither method.

To prevent further growth, neurosurgeons use the X ray; Dr. Hirsch applies radium locally. The endonasal transsphenoidal method, according to the author, gave better results in cases of cystic tumors and also, according to Henderson, in cases in which there were homonymous hemianopsia and central scotoma. According to Henderson and to Cairns (Ox-

ford), the transfrontal method meets with difficulties in prefixed chiasma; the development of mental disturbances may be a risk in elderly people over 60 years of age. Postoperative clotting in the operative field, especially in cystic tumors, was, according to Henderson, the most serious objection to the transfrontal method.

In conclusion, Dr. Hirsch stressed that we should be glad to have, in addition to the irradiation treatment, two operative methods to use according to indication, and to have another available if one fails.

Virgil G. Casten,
Recorder.

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TWO PROBLEMS

For many years two problems of professional conduct have confronted the ethical, honest, and conscientious ophthalmologist. To state them bluntly, and without recourse to diplomacy or subterfuge, they are (1) his attitude towards rebates and (2) his attitude towards the optometrist. They are separate and distinct problems although united by the common bond of economic pressure. It therefore seems best to discuss them separately under a single heading.

The question of rebates is one that has been satisfactorily solved on paper. The national ophthalmic societies have gone on record again and again as condemning them. The resolutions are all on the books for any who may care to read. But, like the prohibition amendment, they were put there in a large measure by those who vote dry but drink wet. Exact figures are not available because of the natural secrecy and reticence involved, but there is every reason to believe that the practice is prevalent and national, and present in small as well as in large communities.

It would be easy to rave and rant about the dishonesty of the acceptance of rebates, about its viciousness, its secrecy, its hypocrisy. It is easy, too, for the well-established, prosperous, well-trained, and skillful ophthalmologist to condemn his weaker fellow for taking rebates, which sometimes make up a large part of his income. But these condemnations do not solve the problem. There is something peculiarly paradoxical about this matter;

something like a split personality, like Jekyl and Hyde, here. The ophthalmologist who would gladly get up in the middle of the night to take care of a charity emergency case is sometimes the same fellow who accepts money paid by his patient to a third party for the sole benefit of the physician's pocket. The fellow who subscribes to the oath of Hippocrates, who honors the great men of medicine, who occupies high and low places in teaching, in medical societies, and in communities is frequently the same fellow who not only accepts rebates, but by some strange twist of logic considers them his just dues, although he most often has nothing to do with the material, overhead, quality, or service sold.

The only argument for the acceptance of rebates that may be considered conciliatory is the one most frequently quoted. It is to the effect that the ophthalmologist's fee is frequently so small and the dispenser's so large that some adjustment is equitable. Nothing is said about the patient. Again it is stated that the ophthalmologist cannot charge a proper fee for his services, especially in a small community, and compete with the optometrist who is in the enviable (?) position of being able to charge for both service and material.

It is also sometimes said that the ophthalmologist is justified in establishing his own dispensing service, either in his office by himself, or by a salaried dispenser, or by a wholesaler who makes the goods but delivers them to the eye physician for fitting. In this way the conscientious ophthalmologist makes certain that the patient's interests are best served.

These arguments, however, still don't solve the question "why rebates?" The ophthalmologist, the dispenser, and the patient have no wish to be parties to the agreement. Certainly not the latter if he knew of it. And this is the nucleus of the viciousness of the practice. It would fall of its own weight if the secrecy were removed.

It is time that this particular stall of the stable of the practice of medicine be cleaned and swept, as were the ones adjacent, those of fee splitting and drug rebates. The patient, who should be considered first, would get his glasses cheaper, the dispenser his bookkeeping simplified and his profits equitably, and the ophthalmologist would regain his self-respect and at the same time rise or fall by his own endeavors. It would spur him on to his best efforts in friendly competition with his fellows and raise the quality of ophthalmic practice.

It is encouraging, therefore, to see arise a movement in a few of the local societies to let the public know in no uncertain terms, terms that are plainly spoken and easily understood, that their members do not accept rebates. At the same time these men are arranging to have glasses supplied to their patients by reputable dispensers in their communities at a lower cost. This movement deserves the applause and support of all physicians worthy of the name.

This brings up another aspect of the problem and that is the difficulty of getting good-quality glasses at a proper cost. There is no more excuse for a patented lens held at high cost than there is for patented insulin held at high cost. A stirring of the public indignation has already occurred, as witness the discussion of this subject in the lay press. If the dispenser is able to send a rebate to the physician and still exist in business, why not to the patient instead? So far, this question has not been satisfactorily answered.

The other problem, that of the relationship of the ophthalmologist to the optometrist, is founded on two similar principles, those of the patient's welfare and the economic competition between the

two groups. Due to the animosity between them charges and counter charges have been hurled, many with justification, some without basis of fact. Without discussing the many knifings in the back that have been done in the past or going into bitter detail of "l'affairs optometrique" let us look at the problem calmly.

In 1935, at Atlantic City, the Section on Ophthalmology adopted a resolution which was accepted by the house of delegates that "the Section on Ophthalmology of the A.M.A. declare that it is unethical for any member of the A.M.A. to give lectures or courses of instruction or to consult with any one not associated with the actual medical service." In the last few years an effort was made to rescind this motion, which was successfully accomplished, so far as the Section was concerned, at its meeting in Cleveland in June, 1941. Since this action was probably the result of the report of a subcommittee of the three major ophthalmic societies, it is interesting to review the matter in order to understand the change in heart of the Section. Dr. Walter B. Lancaster, the chairman of the subcommittee, gave a brief outline of the enormous amount of discussion, the files of correspondence, and the unearthing of facts by which the committee came to its conclusions. He pointed out the millions of people in this country in need of eye care, beginning with school children, continuing with young adults in various industrial and other pursuits and the mature adult with various complications pertinent to that age, and finally those of declining years with their special problems. Balanced against this is the supply of eye specialists to furnish this care. There are 2,000 certified ophthalmologists, and about 6,000 eye, ear, nose, and throat specialists. There are approximately 17,000 optometrists. If the eye cases were distributed in proportion to the number in these groups, he said, about 75 percent would go to optometrists and 25 percent to the medical specialists. According to the data collected by manufacturers and distributors of optical equipment 70 percent of the individuals choose to go to optometrists. The conclusion is inescapable, he stated, that there are not enough eye specialists and particularly ophthalmologists, to meet the needs of the whole population.

The committee was asked by the optometrists to study their course of education and offer suggestions for improvement. The request was obviously sincere and documentary data were freely supplied. The requirements for admission to schools of optometry, some of which are part of high-class universities, the years of training actually given, and the content of the curriculum were tabulated and studied. Dr. Lancaster's report showed that the minimum requirement is 4 years, at least two schools have adopted a 5-year course, and one is talking of a 6-year course. Out of approximately 3,500 optometrists, 619 hold academic degrees from duly accredited colleges and universities apart from the optometric education.

Regarding the men who at present dominate or guide the affairs of the American Optometric Association, Dr. Lancaster said, "The committee with whom we met was made up of the president of the Association and the members of the Council on Education. The chairman of the Council is a member of the staff of the Mayo Clinic, one of the most influental and high-minded of optometrists. Several of the members are ex-presidents of the American Optometric Association.

"It seems to us of great importance that those who guide the affairs of this very large organization (the American Optometric Association) should be men of this

caliber. It shows that there must be a large enough number of men with admirable standards to elect such men.

"Of course, we kept our eyes open for the other side of the picture. There are, as you know, many selfish, venal, commercial, unscrupulous men among the optometrists, as there are in the legal profession and even in the clerical profession, but not, of course, among medical men" (see problem number 1).

Dr. Lancaster went on to say, ". . . it would be more convincing were I to give you not simply the deductions of the committee, but some of the pile of documentary evidence that we have, the syllabuses, the lists of courses and institutions, the descriptions of laboratories and libraries, and letters from a large number of individuals. It is impossible to present the thing with the weight that comes from the accumulative mass of evidence as one studies it over a period of time, but our conviction is that there exist really high-minded optometrists, much as some of you may doubt it, that are really worthy of our help; that they are exerting earnest and effective efforts to elevate the profession of optometry, and that it behooves us to be on the side of efforts to make our influence felt for good."

There is no need to point out here the high caliber of the ophthalmologists who are members of this committee. The Section showed its collective wisdom in accepting the report and voting to rescind the amendment which constituted a barrier to the adequate eye care of the population. The next move is up to the optometrists, and we shall see whether all cats look gray in the light as well as in the dark.

Derrick Vail.

BOOK NOTICES

THE PRINCIPLES AND PRACTICE OF OPHTHALMIC SURGERY. By Edmund B. Spaeth, M.D. Second edition, thoroughly revised. Cloth bound, 886 pages, illustrated with 451 engravings, containing 1149 figures and 6 colored plates. Philadelphia, Lea & Febiger, 1941. Price $10.00.

Enlarged to 886 pages with many added illustrations, the second edition of this well-known and useful book will be generously received, and its popularity increased. It is soundly printed and the illustrations are adequate. The chapters on plastic reconstruction, cataract, and glaucoma are particularly noteworthy. Proper attention is given to the finer details that make for success in retinal-detachment surgery, which is still in the process of evolution. The author has kept well abreast of the extensive modern literature on this as well as other phases of ophthalmic surgery and by the frequent use of verbatim descriptions, succeeds in giving the reader the benefit of his literary research.

The use of many and at times long quotations as well as full abstracts from the medical literature increases the bulk of the book enormously. For this reason it will not appeal so much to the beginner in ophthalmic surgery as it will to the expert. The latter will find that its value is chiefly that of a book of reference. This is not to imply that the author has not expressed his own opinions nor has neglected to discuss his own considerable experiences. Dr. Spaeth has contributed much of originality to ophthalmic surgery and his standing and sound judgment in this field entitle him to the respect which his opinions instill.

Derrick Vail.

TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETY OF AUSTRALIA. Volume 2, 1941. Paper

covers, 110 pages, no illustrations. The Australasian Medical Publishing Company, Ltd., 1941.

This is a report of the second annual meeting of this Society. It was held in Sydney, Australia, on October 10 and 11, 1940. In the absence of the president, A. James Flynn, who was on active service abroad, and the vice-president, Claude-Morlet, the counsel invited Arnold Lance to act as chairman. Eighteen papers were presented. The reader is struck with the attention paid to the subject of the extra-ocular muscles. Even small deviations from the normal are apparently regarded as of considerable importance in aviation.

One of the most interesting papers was on "Visual complications of high-speed flying," by Conrad Blakemore. He discussed the clinical manifestations of "black-outs," attributing these to the flow of blood away from the brain and eyes occasioned by the rotational movements of the plane with the head toward the center of rotations. This causes an insufficiency of oxygen for the retina, which requires four times more than that of any other structure. In the rare maneuver in which the blood is forced toward the head, such as on outside curves, retinal and subconjunctival hemorrhages may be produced.

Three cases of keratitis sicca are reported by J. Bruce Hamilton; they belong to the group of those spontaneously occurring in women after the menopause. He mentions the association with dry mouth, dry skin, and arthritis sicca, and has found Beetham's procedure of obliteration of the canaliculi to be most satisfactory. He divides the disease into two groups: (1) in which the primary lesion is in the lacrimal gland, and (2) in which it is in the cornea. The latter is associated with filamentous keratitis and is much less amenable to treatment than the former. This is greatly helped by the use of fluid simulating tears; namely, 10-per-cent blood serum in Ringer's solution.

Nine interesting short papers on a diversity of subjects follow this, and the volume concludes with the minutes of the meeting, rules of the Society, list of members, and obituary.

Lawrence T. Post.

OBITUARY

CLAUDE THOMAS WOLFE
1883-1941

Dr. Claude Thomas Wolfe died at his home in Louisville, Kentucky, on April 9, 1941. Without having been ill, but apparently in perfect health, he died quietly during the night.

Dr. Claude T. Wolfe

Dr. Wolfe was born in September, 1883, in Corydon, Indiana, the son of Dr. Z. C. and Martha Wolfe. His elementary education was obtained in the Corydon schools. He was graduated from

the Kentucky School of Medicine in 1907. After a period of special study at the Manhattan Eye and Ear Infirmary in New York and at Wills Hospital in Philadelphia, he engaged in general practice for one year in Corydon. Obtaining the appointment of house surgeon in the Chicago Eye and Ear Hospital, he served a year in that institution, then returned to Louisville, in 1911, to establish himself as an eye, ear, nose, and throat specialist; and thus began a career which brought him eminent success and widespread fame.

Immediately he became a member of the faculty in the Department of Ophthalmology, University of Louisville School of Medicine, being promoted in rank steadily until in 1927 he was made clinical professor and head of the Department of Ophthalmology, which position he held until his death. Dr. Wolfe was an efficient, impressive teacher, a keen diagnostician, an excellent surgeon; he was endowed with a most pleasing, winsome personality.

During the World War Dr. Wolfe served for two years as Captain in the Medical Department of the Army, stationed at Fort Oglethorpe, Georgia.

He was past president of the Louisville Eye and Ear Society and the Eye and Ear Section of the State Medical Society, a member of the Kentucky State and American Medical Associations, and of the American Academy of Ophthalmology and Otolaryngology. He was also a member of the Louisville Country Club, Pendennis Club, and Juniper Club.

Dr. Wolfe is survived by his wife, by a daughter, and by a son, Dr. William C. Wolfe, who recently had become associated with his father in practice.

Dr. Wolfe was held in high esteem by all who knew him; his loss is shared by the medical profession and his many friends and patients.

C. Dwight Townes.

ABSTRACT DEPARTMENT

EDITED BY DR. WILIAM H. CRISP
ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

1

GENERAL METHODS OF DIAGNOSIS

Lijo Pavia, J. **Ophthalmoscopy with sodium light in various types of cases.** Rev. Oto-Neuro-Oft., 1940, v. 15, Dec., p. 363.

A detailed account is given of ophthalmoscopic examination by sodium light of a patient with glaucoma simplex, one with a pseudo-alteration of the internal limiting membrane of the retina, and another with choroiditis and retinal detachment.

Edward P. Burch.

Wheeler, J. R. **Sudden failure of vision.** The Practitioner, 1941, v. 146, March, p. 137.

The fundamental facts concerning sudden loss of vision are discussed in six groups: amblyopia (of chronic duration but acutely discovered), vascular lesions, retinal separation, acute glaucoma, sensitivity to various poisons, and injury. Morris Kaplan.

2

THERAPEUTICS AND OPERATIONS

Bellows, J. G., and Chinn, H. **Penetration of sulfathiazole in the eye.** Arch. of Ophth., 1941, v. 25, Feb., pp. 294-298.

The concentration of sulfathiazole in the blood and spinal fluid and in the various ocular tissues and fluids of the dog has been determined from one to 24 hours after oral administration of 0.2 gm. per kilogram of body weight. The maximum concentration was reached from the fourth to the sixth hour. Higher values were obtained consistently when sulfathiazole was given dissolved in hydrochloric acid than when it was given in an aqueous suspension. Only traces of sulfathiazole were found in cerebrospinal fluid, aqueous humor, lens, cornea, and vitreous humor. The other tissues examined, in descending order of concentration, were sclera, conjunctiva, and the chorioretinal layer. A comparison was made of the concentrations in these tis-

sues of sulfanilamide, sulfapyridine, and sulfathiazole similarly administered. The clinical implications of these results are discussed.

J. Hewitt Judd.

Bellows, J. G., and Chinn, H. **Solubility of drugs in buffer solutions.** Arch. of Ophth., 1941, v. 25, Feb., pp. 333-334.

The solubility and reaction of homatropine and paredrine in buffer solutions, prepared according to Gifford, were investigated at various pH levels. In the range investigated (4.20 to 8.75) the solution remained perfectly clear. After addition of the drug a slight alteration in the reaction of the buffer was noted. The greatest changes occurred in the more alkaline solutions. At pH levels above 6.15 the shift was to the acid side, whereas at pH 4.6 the solution became slightly more alkaline.

J. Hewitt Judd.

Borezovskaja, S. **Blood transfusion in ocular diseases.** Viestnik Opht., 1940, v. 17, pt. 4, p. 376.

On the basis of 11 cases the author finds blood transfusion particularly effective in early cases of vitreous opacities, and exudates and precipitates on the anterior lens capsule. The procedure assists in the restoration of intraocular tension, hastens healing of ulcers, and arrests inflammatory processes. In old tuberculous cases it has no effect. Ray K. Daily.

Bujadoux. **Application of new high-frequency currents in ophthalmology, especially in detachment of the retina.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 422.

The author states that the advantage of using a high-frequency generator of modulated waves consists in producing extensive coagulation with a minimum depth of penetration. Its application to superficial tumors of the lids or conjunctiva is perfectly satisfactory, but it is in the treatment of retinal detachment that it has proved most useful. Two cases are reported illustrating the use of such a generator in retinal detachment and in one case of buphthalmos. Jerome B. Thomas.

Dzshanpoladova, A. C. **The use of Ymikov's antituberculin in tuberculous and scrofulous ocular diseases.** Viestnik Opht., 1940, v. 17, pt. 4, p. 445.

Because of its harmlessness this preparation may be used in severe tuberculous cases in which tuberculin is contraindicated. Its action is favorable locally and generally. Under its continued use there are no recurrences; interruption of treatment may bring on a recurrence. Ray K. Daily.

Kolenko, A. B. **Experimental data on the action of thymol and cod-liver oil.** Viestnik Opht., 1940, v. 17, pt. 4, p. 398.

Kolenko reports a laboratory investigation on rabbits, relative to the effectiveness of 10-percent thymol in cod-liver oil as a nonspecific desensitizing agent. The conclusions are that for rabbits the injections of thymol and cod-liver oil are painless and well tolerated; they produce a nonspecific desensitization for a period of three weeks, with some effect persisting after three months. Ray K. Daily.

Luschinskii, G. F., and Gilbert, G. P. **Blood transfusion in ocular diseases.** Viestnik Opht., 1940, v. 17, pt. 4, p. 371.

On the basis of 31 cases of various ocular diseases treated by blood transfusion, the authors conclude that early cases present a suitable field for this type of therapy. It is indicated in trau-

matic opacities of the vitreous without inflammatory phenomena in the anterior uveal segment. In inflammations of the iris and ciliary body, and in parenchymatous keratitis, transfusion was in the authors' cases ineffective.

Ray K. Daily.

P'an, S. Y. **Distribution of sulfanilamide in the ocular fluids and tissues after local application.** Proc. Soc. Exper. Biol. and Med., 1941, v. 46, Jan., p. 31.

After its local application in powdered form to the conjunctival sacs of rabbits, sulfanilamide was found in significant concentrations in the ocular tissues and fluids. Local application of the drug for one hour did not result in an appreciable systemic absorption, no sulfanilamide being detected in blood samples. In both man and rabbits, local application of 100 mg. of finely divided sulfanilamide to the conjunctival sac gave higher concentrations of the drug in the cornea, conjunctiva, sclera, and aqueous humor than were obtained after moderate oral administration of the drug.

Edna M. Reynolds.

Post, M. H. **The sterilization of sharp instruments by chemical solutions.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 624-632; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 37.

Stenstrom, W. K., Burch, E. P., and Walsh, F. M. **Beta irradiation in ophthalmology.** Jour. Lancet, 1941, v. 61, March, p. 69.

The results of beta-ray radiation in 75 patients with lesions of the anterior ocular segment are reported. A description of beta rays and the method of their employment is given. The best results were obtained in lesions where vascularization was a prominent feature, such as interstitial keratitis, tuberculous kerato-iritis, and dendritic ulcers. Radiation at an early stage in these conditions is recommended so as to limit the damage from corneal scarring.

Edna M. Reynolds.

Tatár, Josef. **An improved monocular bandage.** Klin. M. f. Augenh., 1940, v. 105, Dec., pp. 723-724.

Putting one tie of the bandage either under the nose or under the second eye keeps the bandage from slipping. (2 illustrations.)

Gertrude S. Hausmann.

Vladichenskii, A. **A celluloid shield for the open management of postoperative wounds.** Viestnik Opht., 1940, v. 17, pt. 4, p. 465.

The author uses shields made of discarded celluloid photographic film from which the emulsion has been washed. Such shields provide sufficient protection and do not obstruct vision.

Ray K. Daily.

Wilson, Clinton. **A better adhesive tape for use after surgical treatment of the eye.** Arch. of Ophth., 1941, v. 25, Feb., p. 334.

Use of Scotch tape is advocated as a substitute for the adhesive tape treated with zinc oxide because it is convenient, clean, and easily applied and removed. The author has not encountered any dermatitic reactions.

J. Hewitt Judd.

3

PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Abbott, H. B. **A pocket rule for the measurement of accommodation and of convergence.** Arch. of Ophth., 1941, v. 25, Feb., pp. 331-332.

The instrument consists of a semi-rigid flexible steel tape which rolls up on a spring reel into a metal case. The tape is graduated in centimeters and dioptric or meter-angle equivalents. The face of the case consists of a flat card-holder made to hold two white permanent celluloid or renewable paper cards which are freely interchangeable and reversible. A 2-mm. dot and a small, black engraved cross are used as fixation targets in testing convergence, and the Duane line and a line of closely placed black dots are used for testing accommodation. J. Hewitt Judd.

Barbel, I. E., and Benin, P. H. **Rabkin's polychromatic plates.** Viestnik Opht., 1940, v. 17, pt. 4, p. 468.

An evaluation of these plates shows them to be as reliable as the Ishihara plates, and more suitable for the differential diagnosis of color anomalies. Ray K. Daily.

Fortin, E. P. **Entoptic phenomena.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Oct., p. 916.

The author presents a new procedure for the entoptic observation of the retinal vascular tree, the macula, and the papilla. After the eye has been fully dark adapted, the blue rays of a mercury-arc lamp are directed perpendicularly to the visual axis and tangentially to the pupillary plane. The entoptic phenomena occur a few seconds after the exposure. Plinio Montalván.

Jakovlev, P. A. **The effect of sound on the limits of visual color fields.** Viestnik Opht., 1940, v. 17, pt. 4, p. 459.

A laboratory investigation. The findings agree with those found by Kravkov for the macula: sound extends the color fields for blue and green, constricts the field for orange-red, and has no effect on red. Ray K. Daily.

Kinmont, P. **A simple optical appliance for use with respirators.** Brit. Jour. Ophth., 1941, v. 25, March, pp. 122-124.

Difficulties experienced in the usual procedures for adapting spectacles to the common breathing mask are discussed. A fitting has been devised, and is herein described, which is worn outside the mask eyepiece. The fitting is fully discussed as to its advantages. (Figures.) D. F. Harbridge.

Luedde, W. H. **The relation of Meckel's ganglion to accommodation and intraocular tension.** Arch. Neurol. and Psych., 1941, v. 45, March, p. 481. (See Section 8, Glaucoma and ocular tension.)

O'Connor, Roderic. **Practical comments on refraction.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 640-644; also Trans. Western Ophth. Soc., 1940.

Pincus, M. H. **Monocular diplopia.** Amer. Jour. Ophth., 1941, v. 24, May, pp. 503-506.

Riddell, W. J. B. **The problem of color vision in insects.** Glasgow Med. Jour., 1941, v. 135, Feb., p. 48. (See Section 19, Anatomy, embryology, and comparative ophthalmology.)

Zimkin, H. B., Klimovich, E. F., and Lushin, M. I. **Methods of measuring accommodation.** Viestnik Opht., 1940, v. 17, pt. 4, p. 479.

The objectives of this study were: (1) to determine the importance of illumination and of the visual angle subtended by test objects, (2) to evaluate the various methods used, and (3) to develop an accurate and simple method.

The data show that test objects subtending a large visual angle are recognizable not only when in focus on the retina, but also in diffusion circles; this is particularly true in young people with acute vision and active accommodation. The range of accommodation determined with the usual test letters is not exact, but approximate, its deviation from the exact depending on the age of the patient and the angle subtended by the test object. Because of the increased visual acuity with increased illumination, accommodation should be tested in low illumination. The method proposed consists in printing test objects of such diminutive size that the test object used at each distance is at the limit of the patient's visual acuity. Such a test object would become blurred if placed closer to the eye than the near point of accommodation; it would also blur if placed further from the eye, because it would then be beyond the distance of visibility. The near point of clear vision could in this manner be determined accurately.

Ray K. Daily.

4

OCULAR MOVEMENTS

Geller, I. M. **Evaluation of heterophoria tests.** Viestnik Opht., 1940, v. 17, pt. 4, p. 388.

The author points out the errors in the Maddox-rod and Graefe-prism tests, and concludes that the most reliable data are obtained through the use of the phorometer and the Litinski stereomyograph. Ray K. Daily.

Malbran, Jorge. **Etiopathogenesis of strabismus.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Sept., p. 771.

The author states that "motor" fusion is a part of the innate equipment of the newborn, manifested by the ability to fix with both maculas, while "sensorial" fusion is necessarily an acquired function and, consequently, liable to impairment and amenable to development. If a deviation appears before fusion has developed, abnormal retinal correspondence is the rule. On the other hand, if fusion has attained a fair degree of maturity prior to the onset of the strabismus, normal retinal correspondence will prevail despite the motor anomaly. Divergent strabismus is not always due to faulty fusion, but in many cases is the result of anatomic anomalies. In vertical strabismus, anomalies of the position of rest are the basic underlying factors. Oblique strabismus may be due to different causes. In many cases there is a paralysis of the superior oblique with overaction of the inferior oblique. In others the deviation, usually accompanied by nystagmus, is produced by vestibular derangement. In a few cases the cause can be found in an anomalous insertion of the internal rectus. (Statistical tables, bibliography.)

Plinio Montalván.

Martin, L., and Pennell, V. **A case of exophthalmic ophthalmoplegia.** The Lancet, 1941, v. 1, Jan. 11, p. 39.

Martin describes a case of moderate thyrotoxicosis in which ophthalmoplegia with diplopia was an early symptom, but exophthalmos was slight. There was some paresis of both external recti. F. M. Crage.

Reese, W. S., and Yaskin, J. C. **Preservation of convergence with paralysis of all lateral movements in a case of intramedullary tumor of the pons.** Amer. Jour. Ophth., 1941, v. 24, May, pp. 544-549; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 296.

Robbins, A. R. **Divergence paralysis with autopsy report.** Amer. Jour. Ophth., 1941, v. 24, May, pp. 556-557.

Roper, K. L. **Paralysis of convergence.** Arch. of Ophth., 1941, v. 25, Feb., pp. 336-353.

A review of the literature is presented with special reference to the differences of opinion which have existed concerning convergence paralysis, its anatomy, physiology, and pathogenesis. A case of convergence paralysis in a boy aged 13 years is reported. Diplopia for near vision and the inability to converge were constant. Encephalitis was considered a likely causative factor, since there was a history of an acute illness of two-weeks duration preceding the onset of diplopia. Convergence paralysis is a rare condition in which the paralysis remains permanently. The variety of theories and opinions concerning this anomaly emphasizes the need for a better understanding of the anatomy and pathogenesis. J. Hewitt Judd.

Sergievskii, L. I., and Bilit, M. B. **Results of 9½ months experience with orthoptic treatment of concomitant strabismus.** Viestnik Opht., 1940, v. 17, pt. 4, p. 379.

The authors are very enthusiastic about the functional results of orthoptic treatment. They believe that surgery will become an adjuvant to orthoptic training, with the latter assuming primary therapeutic importance.

Ray K. Daily.

Verhage, J. W. C. **Nystagmus in the Netherlands coal fields.** Ophthalmologica, 1940, v. 100, Nov., p. 266.

Statistical comparisons of nystagmus and relevant economic factors are made between Dutch coal mines and those of other places. Photometric measurements made in Dutch mines are reported. The author concludes that the lamp attached to the cap is the best available means of illumination. It provides adequate light without dazzling.

F. Herbert Haessler.

5

CONJUNCTIVA

Albaugh, C. H. **Final diagnosis: bilateral gonorrheal ophthalmia.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 690-693.

Braley, Alson. **Intracellular bodies of the conjunctival epithelial cells.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1940, 91st session, pp. 165-174. (See Amer. Jour. Ophth., 1941, v. 24, Feb., p. 225.)

Chutko, M. B. **Blood titre in phlyctenular disease.** Viestnik Opht., 1940, v. 17, pt. 4, p. 358.

The complement content of the blood was determined in 133 patients, 84 of whom had phlyctenular disease. The data show that in 79.8 percent of the phlyctenular cases the blood titre was lowered; in the control group an insignificant drop was found in 13.3 percent. The blood titre may serve as a diagnostic feature in establishing the allergic character of the disease. Variations in the complement content of the blood may be used prognostically to demonstrate the effectiveness of therapy and the development of immunity.

Ray K. Daily.

Coles, J. D. W. A. **A rickettsia-like organism of the conjunctival epithelium of pigs.** Arch. of Ophth., 1941, v. 25, Jan., pp. 101-112.

The conjunctival epithelial inclusions associated with swine fever are de-

scribed. Evidence in the literature and personal experience indicate that the inclusions are not connected in any way with the virus of hog cholera, but probably constitute the cause of a specific conjunctivitis of pigs. The relation of the inclusions to various other organisms is discussed. (Photomicrographs.) J. Hewitt Judd.

Gekker, I. P. **Atypical forms of diphtheritic conjunctivitis.** Viestnik Opht., 1940, v. 17, pt. 4, p. 431.

The author reports five cases which were verified bacteriologically but were atypical clinically. None had membranes, edema of the lid, or glandular enlargement. The chief characteristics were a thick thready secretion and prolonged duration. The author urges that bacteriologic examination of the conjunctiva, in addition to that of the nose and throat, be required of candidates for admission to nurseries.

Ray K. Daily.

Genet, L. **Bilateral Mooren's ulcer followed by stenosing conjunctivitis. Relations with ocular pemphigus. Syphilis.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 403.

In this case, followed by the writer since 1926, special attention is called to extensive contracting bands of conjunctiva following enucleation of the eye. There had been no burns or ulceration of the conjunctival mucous membrane to account for them. The palpebral fissure was almost completely closed. The question arose as to whether the contracting conjunctivitis might not be due to a mild form of ocular pemphigus.

Jerome B. Thomas.

Koke, M. P. **Conjunctivitis in erythema exudativum multiforme.** Arch. of Ophth., 1941, v. 25, Jan., pp. 78-88.

The ocular complications may be classified as catarrhal, purulent, and pseudomembranous. The catarrhal form is characterized by a mild conjunctivitis which subsides simultaneously with the eruption and leaves no scars. The purulent form presents at times extreme conjunctival chemosis, and corneal ulceration and perforation. The pseudomembranous form is the most devastating and most common ocular complication. The bulbar or palpebral conjunctiva or both may be covered by pseudomembranes. Symblepharon occurs when the process becomes severe. Corneal involvement is almost invariable and usually results in ulceration with perforation or permanent diffuse opacification. Recurrences are common. The author gives a differential diagnosis between this condition and pemphigus, the human form of foot and mouth disease, erythema nodosum, herpetiform dermatitis, and epidermolysis bullosa. Hebra's original depiction and the present conception of the disease are discussed. The literature is reviewed briefly with special attention to the outcome of the conjunctivitis and to the various titles applied to this entity. Three cases are reported illustrating the various forms. No etiologic agent could be found by laboratory procedure or animal inoculation. (Photographs.) J. Hewitt Judd.

Lehrfeld, Louis. **The eyelids and conjunctiva as shock tissues in allergy.** Dis. Eye, Ear, Nose, and Throat, 1941, v. 1, April, p. 100. (See Section 14, Eyelids and lacrimal apparatus.)

Lugossy, Gyula. **The problem of chemotherapy in trachoma.** Ophthalmologica, 1940, v. 100, Nov., p. 277. (See Amer. Jour. Ophth., 1940, v. 23, May, p. 583.)

Thompson, R., and Gallardo, E. **The antibacterial action of tears on staphylococci.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 635-640.

Thygeson, Phillips. **Treatment of inclusion conjunctivitis with sulfanilamide.** Arch. of Ophth., 1941, v. 25, Feb., pp. 217-227; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 111.

The results tabulated and summarized in this report show that sulfanilamide is effective in causing rapid healing of inclusion conjunctivitis in infants and adults as well as of the experimental disease in monkeys and baboons. Adults with predominant papillary hypertrophy responded more rapidly than those with predominant follicular hypertrophy. The characteristic epithelial-cell inclusions could always be demonstrated during the first two days of therapy but could not be found after the third day. Infectivity of epithelial scrapings for baboons also disappeared during treatment. In addition to the four adults and ten infants treated with oral administration of the drug, two infants were treated locally with a saturated 0.8-percent solution of sulfanilamide in physiologic solution of sodium chloride. The findings on the effect of local sulfanilamide therapy were inconclusive. (Discussion.)

J. Hewitt Judd.

Tiscornia, A., Moret, R. L., and Tiscornia, B. J. **Sulfanilamide in treatment of complications of trachoma.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Sept., p. 825.

The authors conclude from their clinical observations that sulfanilamide is a highly effective medication, superior in its action to any other drug used in the treatment of trachoma. Photophobia, lacrimation, blepharospasm, pannus, and corneal infiltrates yield rapidly to the action of sulfanilamide. The specific follicles and granulations, however, have not been markedly influenced during the period of time covered by the authors' clinical experimentation. Visual acuity improved as the symptoms subsided.

The treatment of trachoma with sulfanilamide must be instituted early, and large effective doses are superior to small or fractional ones. The treatment must not be prolonged, but made rather short and intensive. The early and rapid improvement of the symptoms must not be confused with a radical cure, and sulfanilamide should be continued and the patient kept under observation until the disease has been eradicated. (The literature is reviewed.) Plinio Montalván.

Verhoeff, F. H. **Leptotrichosis conjunctivae (Parinaud's conjunctivitis) without glandular involvement.** Arch. of Ophth., 1941, v. 25, Jan., pp. 1-6; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 176.

A boy, aged 2 years and 4 months, presented leptotrichosis conjunctivae without involvement of the preauricular or other regional lymph glands. Microscopic examination showed typical lesions with leptothrix abundantly demonstrated in sections. The author assumes that if the condition described by Parinaud is leptotrichosis conjunctivae, then it can now be stated that adenopathy is not an essential feature of the syndrome. J. Hewitt Judd.

Zshiv, V. V. **Rickettsia in trachoma.** Viestnik Opht., 1940, v. 17, pt. 4, p. 409.

An exhaustive histologic study of the alimentary canals of lice from trachomatous patients, and from people with normal eyes from trachomatous

and nontrachomatous regions. The author concludes that the theory of Cuénod and Nataf was based on artefacts. (Photomicrographs.) Ray K. Daily.

6

CORNEA AND SCLERA

Ascher, K. W. **Partial coloboma of the scleral-limbus zone with visible Schlemm's canal.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 615-619.

Bailliart, P. **A case of abnormal bilateral ectasia of the cornea with trophic disturbances.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 351.

In a girl of two years both corneas were opaque, dry, and staphylomatous, the left one perforated. The anterior segments of the eyeballs protruded like those of a lobster. There was a general diagnosis of dystrophy with frontal bosses, osteochondritis, and affection of the parathyroids, doubtless of specific origin. The author suggests that the ocular disorder may have originated in almost complete absence of lacrimal secretion. Jerome B. Thomas.

Bonnet, P. **Sector topography of corneal lesions in zona ophthalmica.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 434.

A case report of ophthalmic herpes. Interstitial keratitis affecting the cornea about the 2-o'clock meridian pointed to involvement of the ciliary-nerve fiber which supplied that sector. Such a selective involvement, affecting certain sectors of the cornea, agrees with our conception of the nature of zona as a neurotropic virus.

Jerome B. Thomas.

Cameron, Walter. **Krukenberg spindle associated with megalocornea and posterior pigmentation of the lens.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 687-689.

Danielson, R. W., and Long, J. C. **Keratitis due to mumps.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 655-657.

Duggan, W. F. **Role of anoxia in the production of episcleritis and scleritis; treatment with vasodilators.** Arch. of Ophth., 1941, v. 25, Jan., pp. 113-121.

The pathologic picture, treatment, pathologic physiology, and etiology are discussed to show that the acute nonpyogenic scleral inflammations are manifestations of acute localized tissue anoxia and are due to increased capillary permeability or arteriolar spasm, or both. The similarity of the early pathologic changes to those of acute retrobulbar neuritis, acute exudative choroiditis, and acute uveal disease is pointed out. The vascular changes are the final common pathway whereby a number of different etiologic factors, many of endogenous origin, produce the same clinical lesion. Hypersensitive arterioles and capillaries account for the sharply localized lesions. In the five cases reported, treatment with vasodilators was of value in effecting a rapid amelioration of signs and symptoms in from three to eight days. This treatment is not empiric but is based on consideration of the pathologic physiology producing the lesions. Although all patients may not respond, this treatment is definitely indicated for conditions which have formerly been attributed to allergy, focal infection, exposure to cold, or tuberculosis. For these conditions a primary histamine origin is worthy of consideration. In cases in which there are obvious vitamin or other deficiencies, patent vascular channels insure a better opportunity for

these substances to be transported to the site of the lesion. J. Hewitt Judd.

Elliot, A. J., Chamberlain, W. P., Jr., and Givner, I. **Diplobacillus of Petit in corneal ulceration.** Arch. of Ophth., 1941, v. 25, Feb., pp. 280-293.

Three cases of corneal ulceration are reported in which the diplobacillus of Petit was isolated. The ulcer is usually gray and centrally located, and the corneal involvement may be both superficial and deep. Culturally the diplobacillus of Petit can be differentiated from the Morax-Axenfeld diplobacillus by its ready growth on ordinary serum-free mediums and its liquefaction of gelatin at room temperature. The production of long chains on chocolate agar and the presence of metachromatic granules when the culture was stained with methylene blue were observed with the diplobacillus of Petit. It has been demonstrated that the organism can grow under anaerobic conditions. Hypopyon keratitis was produced experimentally in the cornea of a rabbit with a culture taken from each of the patients. Antibodies were not demonstrable in the blood serum of a patient with an extensive infection of the cornea caused by the diplobacillus of Petit. An immune serum produced by inoculating a rabbit with the diplobacilli from one patient agglutinated the diplobacilli from another. (Photographs, photomicrographs.)

J. Hewitt Judd.

Gekhtman, M. I. **Subconjunctival injections of mercury oxycyanide in trachomatous pannus.** Viestnik Opht., 1940, v. 17, pt. 4, p. 418.

The results on ninety patients have convinced the author that this is a valuable therapeutic procedure in pannus.

Ray K. Daily.

Genet, L. **Congenital syphilis of the lid in the form of a suppurative pseudochalazion, followed by interstitial keratitis.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 446. (See Section 14, Eyelids and lacrimal apparatus.)

Genet, L. **Syphilitic interstitial keratitis and allergy.** Bull. Soc. d'Opht. de Paris, 1939, June, p. 442.

In this case syphilitic tarsitis was rapidly followed by interstitial keratitis. The author concludes that it is not possible to say whether or not interstitial keratitis is an allergic manifestation of syphilis; that it is closely connected with congenital syphilis, though it does not react to antisyphilitic treatment as do the other lesions.

Jerome B. Thomas.

Goldberg, H. K., and Schlivek, K. **Necrosis of the cornea due to vitamin-A deficiency.** Arch. of Ophth., 1941, v. 25, Jan., pp. 122-127.

The authors report a case of keratomalacia due to faulty absorption of vitamin A in a 23-year-old white woman. It is emphasized that though sufficient vitamins may be included in the diet, absorption may be faulty, and in extreme cases parenteral administration of the vitamin is indicated. This patient was given 100,000 units of vitamin A intramuscularly on three successive days. On the third day the eyes had cleared remarkably, and there was beginning vascularization of the corneal defect. A determination of the level of vitamin A in the blood provides an objective laboratory method of determining whether a deficiency is present. (Discussion.) J. Hewitt Judd.

Hoehne, K. **Interstitial keratitis.** Klin. M. f. Augenh., 1940, v. 105, Dec., pp. 656-693.

Comparing statistics from the literature and his own experience the author found a prevalence of about 7.5 of females among those afflicted with interstitial keratitis. The onset of the disease was mostly between the ages of six and twenty years. About four percent were found to have a negative Wassermann reaction. The occurrence of the keratitis seemed to have no relation to the violence of the syphilitic infection. The increase of tension which is rather frequent in interstitial keratitis produces the astigmatism. High myopia is another sequel of this inflammation. About 58 percent of the patients recovered good vision in the better eye, and 40 percent good vision in the poorer eye. In about 15 percent the vision was so poor as to make the individuals unacceptable for most forms of employment. Investigation of twenty cases, ten years after the interstitial keratitis, showed no other manifestation of congenital lues. Interstitial keratitis is not a direct spirochete infection, but is most likely an immune biologic adjustment of the corneal tissues. Malaria, fever therapy, and antiluetic treatment had no definite influence on the keratitis. Typhoid vaccine and prophylactic X-ray to the unaffected eye have not yet been investigated sufficiently.

Gertrude S. Hausmann.

Katznelson, A. B. **Allergic phenomena in the cornea.** Viestnik Opht., 1940, v. 17, pt. 4, p. 339.

A review of the literature, and tabulated data on the author's own investigation with injections of horse serum into the parenchyma of the normal cornea of sensitized animals, and into the parenchyma of the previously vascularized cornea of sensitized and of normal animals. In the vascularized cornea of normal animals the response to an intracorneal injection of horse serum was a brief inflammatory reaction without allergic characteristics. The allergic reactions in the cornea were always accompanied by allergic phenomena in the iris and conjunctiva; this was scarcely ever seen in the control animals. The author concludes that the normal cornea is rarely the seat of an allergic reaction; in the vascularized cornea an allergic reaction develops readily with edema, stasis, and hemorrhage without necrosis, the reaction lasting five to seven days.

Ray K. Daily.

Koyanagi, Y. **A contribution to the pathologic anatomy and pathogenesis of rodent ulcer of the cornea.** Graefe's Arch., 1940, v. 141, pts. 4 and 5, pp. 358-373.

On the basis of one case of rodent ulcer of the cornea, which was followed clinically for five months and was then studied histologically, the author concludes that rodent ulcer of the cornea is a form of basal-cell carcinoma. This conclusion is drawn from the following histologic observations: There is an irregular growth of corneal basal epithelium at the borders of the ulcer and in the granulation tissue. This epithelium is abnormal as it occurs not only in the form of epithelial plugs and syncytial-cell collections, but, more important, frequently in the form of epitheliogenic connective tissue. This latter type of tissue cannot be considered as part of a simple reparatory process. The ulceration is most severe where the abnormal basal epithelium penetrates most deeply. At the ulcer borders the abnormal basal epithelium is observed to penetrate under the relatively normal edges. The author assumes that the abnormal growth of the

basal epithelium precedes and probably is the cause of the ulcer and suggests that it is a form of basal-cell carcinoma.

Frances C. Cogan.

Langer, Z. M. **Fixation of the corneal transplant by Awerbach's method with cadaver conjunctiva.** Viestnik Opht., 1940, v. 18, pt. 4, p. 406.

Four case reports illustrate the effectiveness of cadaver conjunctiva as a shield for the corneal transplant. It acts well, is always available, and its use makes it unnecessary to traumatize the patient's conjunctival sac. (Illustrations.) Ray K. Daily.

Lehrfeld, L., and Brav, S. S. **Blood-staining of the cornea due to subconjunctival hemorrhage.** Arch. of Ophth., 1941, v. 25, Feb., pp. 329-331.

A review of the literature on the subject of blood-staining of the cornea is presented and the case is reported of a man aged 56 years, in whom a massive subconjunctival hemorrhage was the etiologic factor. It is thought that only when the subconjunctival hemorrhage is massive enough to separate the conjunctiva which is firmly adherent at the limbus can the pigment be absorbed directly into the substantia propria of the cornea. J. Hewitt Judd.

Loewenstein, Arnold. **Lipoid droplets in the episclera as a regular change with age.** Ophthalmologica, 1940, v. 100, Dec., p. 345.

In elderly people, tiny translucent spherules, singly or in groups, are seen in the episclera of both eyes with the help of the narrow beam of the slit-lamp. They are thought to consist of lipoid and to be a normal senile manifestation comparable to gerontoxon.

F. Herbert Haessler.

McKinney, J. W. **Transplantation of the cornea as a means of restoring vision.** Dis. Eye, Ear, Nose, and Throat, 1941, v. 1, April, p. 109.

Corneal transplantation is reviewed. Its development, surgical indications, and source of material are briefly discussed. The method of Castroviejo is the author's choice. The results in 21 cases are briefly summarized.

F. M. Crage.

Pascheff, E. **New findings in the histology of follicular pannus.** Klin. M. f. Augenh., 1940, v. 105, Dec., pp. 648-655.

Histologic examination of a pannus revealed follicles with germinative centers. Six months after excision of this pannus and transplantation of mucous membrane from the mouth the inflammation recurred. Histologic examination showed new follicles with germinative centers in the transplant. The large number of follicles differentiates this tissue from vernal conjunctivitis, where fewer follicles are found, and from granulation tissue, which is without follicles even in cases of trachoma. The trachomatous pannus therefore is a real trachoma of the cornea. (7 illustrations.) Gertrude S. Hausmann.

Schmidt, Martin. **Therapy of keratoconjunctivitis sicca.** Klin. M. f. Augenh., 1940, v. 105, Dec., pp. 694-701.

Eight cases of unilateral keratoconjunctivitis sicca are reported. After other local treatment had proved unsuccessful, the upper and lower tearpoints were sealed with the diathermy needle. The good result was in all cases prompt and permanent.

Gertrude S. Hausmann.

Suganuma, Sadao. **Pathogenesis of progressive scleroperikeratitis.** Klin.

M. f. Augenh., 1940, v. 105, Dec., pp. 702-707.

The symptomatology and histology of a case of "progressive scleroperikeratitis" are described. Tuberculin and Wassermann reactions were both positive. Tuberculin treatment produced no improvement, but antiluetic treatment improved the condition of the second eye. Histologic examination showed luetic panarteritis of the anterior ciliary arteries. (4 illustrations.)

Gertrude S. Hausmann.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Adrogué, E., and Cammarota, A. **A case of tonic pupil.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Sept., p. 863.

Adrogué reports a case of tonic pupil in a woman 22 years of age. The history and general physical and neurologic examinations were essentially negative. Two years previously the patient had complained of periorbital pain in the right side, followed by vomiting. After this episode the right pupil was found to be larger than the left. The direct and consensual light reflexes were absent in the right eye, and a prolonged miosis lasting about 75 seconds was produced by the accommodation-convergence stimulus. The pupil also reacted energetically to the action of pilocarpine. The left pupil was essentially normal. Accommodation amplitude was normal in both eyes. Outside of the suggestive data of migraine in the history, no etiologic factor could be found to account for the condition. Differentiation from Adie's syndrome was based mainly on the presence of tendon reflexes and the noncongenital character of the pupillary anomaly.

Plinio Montalván.

Berens, C., and Nilson, E. L. **Experimental acute iridocyclitis in rabbits produced by coliform bacteria isolated from the upper respiratory tract of man.** Amer. Jour. Ophth., 1941, June, v. 24, pp. 645-654; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 214.

Berezinskaja, D. I. **The significance of p_H in the diffusion of alkaloids into the anterior chamber.** Viestnik Opht., 1940, v. 17, pt. 4, p. 400.

A review of the literature and a laboratory study on the influence of p_H on the effectiveness of eserine, pilocarpine, and atropine. The conclusions are that the three alkaloids act more rapidly and effectively in alkaline media.

Ray K. Daily.

Horay, Gusztáv. **The pathogenesis of sympathetic ophthalmia.** Szemészet, 1940, v. 3, Dec., p. 10.

The author discusses the various theories relating to the cause and origin of sympathetic ophthalmia and concludes that there must be an unknown factor, different in various cases, whose presence is necessary for the development of the disease.

R. Grunfeld.

Kunitzkaja, L. V. **Ocular involvement in brucellosis.** Viestnik Opht., 1940, v. 17, pt. 4, p. 449.

A report of three cases of iridocyclitis complicating brucellosis.

Ray K. Daily.

Leathart, P. W. **The tabetic pupil.** Brit. Jour. Ophth., 1941, v. 25, March, pp. 111-116.

Anatomic, pathologic, and neurologic details are presented with regard to abnormalities in the movements and size of the pupil in disease. The

anatomy of the three primary reflexes is described in detail, as are the characteristics of the tabetic pupil.

D. F. Harbridge.

Luzsa, Endre. **Remarks on X-ray treatment of tuberculous iridocyclitis.** Szemészet, 1940, v. 3, Dec., p. 30.

After reviewing the literature on X-ray therapy of tuberculous uveitis, the author claims that he achieved the best results in the proliferative form of iritis with numerous tubercles but in which the ciliary body was not affected, and in the exudative form of iritis with numerous precipitates and frequent recurrences, which form may be considered the allergic type of tuberculous uveitis. In X-ray therapy of the chronic form of tuberculous uveitis with numerous precipitates and flat posterior adhesions, the results were very poor. The radiation was carried out according to the method of Werdenberg, starting with small and continuing with gradually increasing doses. In some cases no results were obtained until the author resorted to high doses.

R. Grunfeld.

McGuire, H. H., and McGuire, W. P. **Late developments in a case of gyrate atrophy of the choroid and retina (Fuchs).** Amer. Jour. Ophth., 1941, v. 24, June, pp. 657-663; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 307.

Sniderman, H. R. **Boeck's sarcoid of the lacrimal gland; with bilateral iridocyclitis.** Amer. Jour Ophth., 1941, v. 24, June, pp. 675-680.

Tikhomirov, A. A. **Vitreous changes in tuberculous choroiditis.** Viestnik Opht., 1940, v. 17, pt. 4, p. 352. (See Section 10, Retina and vitreous.)

8

GLAUCOMA AND OCULAR TENSION

Ballantyne, A. J. (See also Cruise, Richard.) **Discussion on the choice of operation in glaucoma.** Trans. Ophth. Soc. United Kingdom, 1940, v. 60, pp. 3-32.

The rational treatment of glaucoma is based on the conception of the pathogenesis of the disease. It is assumed that medicinal treatment is inadequate and that some operation is necessary to maintain an intraocular tension at a safe level. The best operation is usually that one which the operator can do most deftly. The various types of surgical procedures are discussed.

Beulah Cushman.

Beach, S. J., and Holt, E. E., Jr. **A rare form of glaucoma.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 668-673; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 266.

Blaauw, E. E. **A microscopic study of the central lens capsule in glaucoma capsulare.** Arch. of Ophth., 1941, v. 25, Jan., pp. 12-24.

The histologic changes in this condition previously reported are summarized. The capsular changes of the cataractous lens of a woman aged 65 years, in whom exfoliation was diagnosed with the slitlamp, are described and illustrated with photomicrographs. The question is raised as to whether this process is one of histolysis or whether the process is only a degenerative one due to senescence, beginning with dystrophy of the capsular epithelium. J. Hewitt Judd.

Bonnet, P., and Chauviré, E. **Chronic traumatic glaucoma secondary to disturbance due to remote shock.** Bull.

Soc. d'Opht. de Paris, 1939, June, p. 398.

The patient was thrown from his bicycle, landing on his forehead on the pavement. He was taken to the hospital in an unconscious state and remained there three days. Wounds of the frontal region were sutured, but no ocular injury was reported. About four months later the left eye first saw halos around electric lights. This was soon followed by failing vision and severe headaches. He was first seen by the authors 18 months after the injury, when the vision of the left eye was reduced to 1/50, the visual field contracted to 5°, the eye hard, and the disc excavated. The right eye was normal in all respects. The case is interesting as a demonstration of the fact that an extra-orbital shock may lead to chronic glaucoma. The pathogenesis may possibly depend on a disturbance of the ciliary epithelium caused by traction on the zonule; or on a vasomotor reaction of sympathetic origin, in accordance with Magitot's theory.

Jerome B. Thomas.

Cruise, Richard. (See also Ballantyne, A. J.) **Discussion on the choice of operation in glaucoma.** Trans. Ophth. Soc. United Kingdom, 1940, v. 60, pp. 33-38.

The author states that after 25-years experience his choice of operation for chronic glaucoma is a hinged-flap sclerotomy of the Herbert type with immediate massage. The technique and advantages are discussed. (Illustrations.)

Beulah Cushman.

Gradle, H. S. **Tension tolerance.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1940, 91st session, pages 17-19. (See Amer. Jour. Ophth., 1940, v. 23, Oct., p. 1197.)

Luedde, W. H. **The relation of Meckel's ganglion to accommodation and intraocular tension.** Arch. Neurology and Psychiatry, 1941, v. 45, March, p. 481.

Luedde reports several cases in which he believes that nasal disorders had an influence on the onset and course of intraocular hypertension. He also reports several cases to show that anesthetizing of Meckel's ganglion relieves spasm of accommodation and its symptoms. Theodore M. Shapira.

Rokitzkaja, L. V. **Dark adaptation in glaucoma after a unilateral surgical procedure.** Viestnik Opht., 1940, v. 17, pt. 4, p. 363.

The dark-adaptation curves of both eyes were studied in 17 patients each of whom had had one eye operated upon for glaucoma. The data show an improvement in the darp adaptation of both eyes. The increased sensitivity of the fellow eye was a constant occurrence, lasting longer than the bilateral ophthalmologic reactions. The improvement in dark adaptation cannot be accounted for by a change in the peripheral conditions, and has to be attributed to processes taking place in the central nervous system as a result of reflex stimulation. The emotional state of the organism is of importance in reflex activity, and the improved emotional attitude following a successful operation may account for the improved adaptation curve. The delayed adaptation curve is one of the symptoms of glaucoma and is independent of visual acuity or visual fields. It is related somewhat more closely to the intraocular tension, but the two are by no means parallel. Not infrequently the intraocular tension is found to be raised at the completion of an examination for dark adaptation. This examina-

tion therefore may be considered as a provocative test. The rise in tension takes place also in cases in which the pupil has been immobilized by pilocarpine, indicating that the reaction is not purely mechanical, as claimed by Seidel and Grönholm, but that it emanates from the central nervous system.

Ray K. Daily.

Schlaeppi, V. **The influence of posterior pituitary extracts on the pupil and intraocular tension.** Ophthalmologica, 1940, v. 100, Dec., p. 321.

The conflicting results reported in the literature can be explained by differences in concentration of the active principle. The author offers evidence by means of clinical and experimental studies of the eyes of patients and rabbits. He used the purest possible extracts of the posterior pituitary (the hypertensive hormone or vasopressin, and the uterus effector or oxytocin) by intravenous, subcutaneous, and subconjunctival injections, and by instillation into the conjunctival sac.

In the rabbit vasopressin in large doses caused miosis and decrease of tension. Smaller doses with slower administration effected mydriasis but decreased tension. Only in very weak dilutions did vasopressin cause increase of tension. Oxytocin in high concentration behaved like weak solutions of vasopressin. In man, vasopressin behaved like weaker solutions of vasopressin do in rabbits, and oxytocin was without effect. In glaucoma the action of vasopressin was not constant.

F. Herbert Haessler.

9

CRYSTALLINE LENS

Berens, Conrad. **A new capsule forceps.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 689-690.

Blaauw, E. E. **A microscopic study of the central lens capsule in glaucoma capsulare.** Arch. of Ophth., 1941, v. 25, Jan., pp. 12-24. (See Section 8, Glaucoma and ocular tension.)

Cameron, Walter. **Krukenberg spindle associated with megalocornea and posterior pigmentation of the lens.** Amer. Jour Ophth., 1941, v. 24, June, pp. 687-689.

Chance, Burton. **Removal of the lens in high myopia in which lenticular opacities prevent improvement of vision by correcting lenses.** Amer. Jour. Ophth., 1941, v. 24, May, pp. 519-525; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 69.

Ellis, R. W. B. **Arachnodactyly and ectopia lentis in a father and daughter.** Arch. Dis. in Childhood, 1940, v. 15, Dec., p. 267.

The author thinks it probable that both arachnodactyly and ectopia lentis may be transmitted as mendelian dominants, either separately or in association. There is no sex linkage in either condition.

Theodore M. Shapira.

Korobko, B. G. **Simultaneous capsulotomy and section in cataract extractions.** Viestnik Opht., 1940, v. 17, pt. 4, p. 434.

The author believes that making the capsulotomy with the point of the Graefe knife, as it goes across the anterior chamber in making the section, improves postoperative results.

Ray K. Daily.

Leonibus, Fernando de. **Oxidation of certain fatty acids and esters of fatty acids by surviving lens substance.** Ann. di Ottal., 1940, v. 68, Feb., pp. 128-135.

After a review of various modern theories of lipid metabolism the author reports his own experiments, the results of which are given in four tables. The cortical fibers of freshly removed normal lenses of oxen and rabbits were separated into lamellae and kept alive in Ringer's solution (without bicarbonate, in accordance with Warburg) in an atmosphere of oxygen. The pH was kept at 7.2 by means of a buffered system of phosphates. The sodium salts of certain monocarboxylic fatty acids (such as formic, acetic, propionic), as also their methyl and ethyl esters, were added and the oxidation quotients manometrically determined in each case before and after the addition of the acids or their esters. It was found that the consumption of oxygen was in most instances increased, and that the esters were oxidized in greater measure than the acids. Thus the normal lens cortex does not differ from other normal tissues with respect to lipid metabolism, whereas neoplastic tissues can oxidize only the esters. The author's opinion is that the acids are beta-oxidized; in the case of the esters he thinks that omega-oxidation is more likely.

Harry K. Messenger.

Milner, J. G. **Allergic eczema and cataract.** Brit. Med. Jour., 1941, March 8, p. 356.

Because the lens is so rarely affected in skin disease, a case is reported in which anterior cataract was associated directly with generalized allergic eczema.

Edna M. Reynolds.

Ratinova, K. A. **The effect of diathermy on the absorption of cortical lens masses.** Viestnik Opht., 1940, v. 17, pt. 4, p. 436.

The application of this form of physiotherapy to 35 postoperative discission and flap-extraction cases lead the author to believe that it is more effective than injections of dionin and saline.

Ray K. Daily.

Rumbaur, W. **My experiences with intracapsular extraction of senile cataract.** Klin. M. f. Augenh., 1941, v. 106, Jan., pp. 36-44.

The advantages of intracapsular extraction are a shorter healing period and elimination of secondary cataract. The complications are prolapse of the vitreous, prolapse of the iris, and postoperative hemorrhages. By adequate preoperative care, the use of akinesis, a fixation suture through the superior rectus muscle, and a retrobulbar injection, the dangers can be minimized.

Gertrude S. Hausmann.

Salit, P. W. **Seasonal variations in lipid content of crystalline lenses; with special reference to the influence of sunshine and humidity.** Arch. of Ophth., 1941, v. 25, Jan., pp. 32-35.

The total lipid and cholesterol contents of 267 human cataractous lenses, obtained from residents of Iowa with an average age of 69.3 years, were studied over a period of 27 consecutive months. The results were plotted in relation to temperature, sunshine, and humidity. Definite variations in both lipid and cholesterol content were found, the amount of lipid being more pronounced on the basis of percentage and that of cholesterol on the basis of absolute amount. The total lipid varied directly with sunshine; the cholesterol varied inversely with humidity. It is concluded that the inverse relation of the cholesterol to humidity represents a phase of a bipolar chemicophysiologic system in which the phospholipids represent the opposite phase, and,

therefore, would be expected to vary directly with humidity. Such a chemicophysiologic system, in which one of the chemical factors is hydrophobic and the other hydrophilic, the two varying inversely to each other according to the moisture content of the atmosphere, must have something to do with the water transportation and consequently also with the temperature regulation of the tissues. J. Hewitt Judd.

Smelser, G. K. **An attempt to produce dinitrophenol cataracts in hypothyroid rats.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 680-681.

Suden, C. T. **Opacities of the lens induced by adrenalin in the mouse.** Amer. Jour. Physiology, 1940, v. 130, Sept. 1, p. 543.

The author finds that reversible subcapsular lens opacities are produced in mice after single intraperitoneal injections of adrenalin in amounts which are toxic but not fatal. Moderate amounts of histamine given a few minutes before the injection of adrenalin increases the incidence of opacities. The process of opacification appears to be related to some aspect of the carbohydrate disturbance. Theodore M. Shapira.

Sukhov, S. V. **Frequency of secondary cataract; its surgery and complications.** Viestnik Opht., 1940, v. 17, pt. 4, p. 451.

Secondary cataract developed in 20 percent of the combined extractions performed at the Ukraine Ophthalmologic Institute. The treatment was discission. The author believes that a vitreous hernia into the anterior chamber does not predispose to glaucoma and retinal detachment, and that glaucoma following discission develops only in predisposed eyes. One of 52 eyes treated by discission was lost through cicatrization of the vitreous and anterior uvea. Ray K. Daily.

Swan, K. C., and Salit, P. W. **Lens opacities associated with experimental calcium deficiency.** Amer. Jour. Ophth., 1941, v. 24, June, pp. 611-614.

Urrets Zavalia, A. and Oliva, R. O. **Considerations on two cases of anterior lentiglobus.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Sept., p. 848.

Two brothers, 23 and 15 years old respectively, presented typical uncomplicated anterior lentiglobus, developed at puberty. In one case the condition was bilateral, while in the other, although unilateral, the fellow eye showed an anterior central capsular cataract. The consanguinity of the parents (cousins) is stressed. The different pathogenic theories are discussed in detail. (Color plates, bibliography.) Plinio Montalván.

Vázquez Barriere, A. **Congenital annular cataract.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Oct., p. 877.

Bilateral congenital annular cataracts, with nystagmus, were present in a man 34 years of age. The calcified, subluxated lens in the left eye was removed and some improvement in vision was obtained. (Color plate, illustrations). Plinio Montalván.

Weekers, Roger. **The role of calcium in the carbohydrate metabolism of the lens.** Ophthalmologica, 1940, v. 100, Nov., p. 257.

The author presents a résumé of facts reported in 56 articles in the literature and of experiments of his own in order to illuminate the problem of the role

of calcium in the metabolism of the lens. Glucose disappears from watery extracts of lenses of rabbits and heifers. The addition of sodium fluoride, oxalate, or citrate prevents glycolysis, and the addition of calcium chloride does not re-establish the process. Calcium is necessary for the carbohydrate metabolism of the lens and alteration in the physicochemical relations may lead to irreversible harmful changes.

F. Herbert Haessler.

Zenkina, I. B. **Tunica vasculosa lentis.** Viestnik Opht., 1940, v. 16, pt. 6, p. 514.

A case which was sent in for an enucleation with the diagnosis of sarcoma of the ciliary body was found to be a case of persistent tunica vasculosa lentis and posterior capsular cataract.

Ray K. Daily.

10

RETINA AND VITREOUS

Bangerter, A. **A method of closure of retinal holes near the posterior pole.** Ophthalmologica, 1940, v. 100, Dec., p. 351.

A small retinal hole near the region of the posterior pole can be reached operatively only if the movements of the instrument can be constantly controlled by direct observation. To accomplish this, the author has devised the following procedure: After lifting a conjunctival flap temporally, the sclera is thinned just posterior to the ciliary body by means of a 1-mm. trephine. Goldman's retinal contact glass is then used for observation at the slitlamp. A diathermy needle, which is insulated throughout except for its tip, is used to puncture the thin spot in the sclera. The current is then turned off and the needle is pushed through the vitreous and retinal hole under constant slitlamp observation. When the tip reaches the choroid the current is closed momentarily. A small cautery spot is produced and the needle is removed. The method proved to be successful in one eye that had seemed hopeless.

F. Herbert Haessler.

Busacca, Archimede. **The genesis of the crossing phenomenon of retinal vessels.** Folia Clin. et Biol., 1941, v. 13, no. 1, p. 1.

The author discusses the views of Gunn, Raehlmann, Salus, and others as to the displacement of the veins in arteriosclerosis by the overlying artery at the point of crossing. His own idea is that the real cause of the displacement lies in an elongation of the vessel. This explains the possible existence of cases of arterial hypertension without modification at the points of crossing, and gives a pathologic anatomic reason for the alterations. (6 figures.)

Eugene M. Blake.

Dasheskii, A. M. **A new adaptometer model.** Viestnik Opht., 1940, v. 17, pt. 4, p. 464.

A description of the instrument.

Jervis, G. A., **Juvenile amaurotic family idiocy.** Amer. Jour. Dis. of Children, 1941, v. 61, Feb., p. 327.

Clinical data in six cases of juvenile amaurotic family idiocy occurring in the same family are reported. The pathologic observations in one of these cases is described.

Theodore M. Shapira.

Krasilchikova, E. M. **Acetylcholine in the treatment of embolism of the central retinal artery.** Viestnik Opht., 1940, v. 17, pt. 4, p. 427.

In 13 out of 23 cases subconjunctival

injections of acetylcholine acted well. For good results the treatment should be prompt. (Four case reports.)

Ray K. Daily.

McGuire, H. H., and McGuire, W. P. **Late developments in a case of gyrate atrophy of the choroid and retina (Fuchs).** Amer. Jour. Ophth., 1941, v. 24, June, pp. 657-663; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 307.

Patek, A. J., Jr., and Haig, C. **Effect of administration of thyroid extract and of a-dinitrophenol upon dark adaptation.** Proc. Soc. Exper. Biol. and Med., 1941, v. 46, Jan., p. 180.

Oral administration of thyroid extract or a-dinitrophenol to three patients with markedly prolonged dark adaptation (due in two cases to cirrhosis of the liver and in the other case to renal stone) produced a decided increase in speed of adaptation and lowering of visual thresholds. The type of response was similar to that observed with vitamin-A therapy but was accelerated. In one case in which 250,000 to 500,000 international units of vitamin A daily for two months had been necessary to secure normal dark adaptation, the same result was obtained in from three to ten days after the feeding of either thyroid extract or a-dinitrophenol. The serum vitamin A was decreased during therapy. The improvement in speed and extent of rod adaptation was greater than that of cone adaptation. The changes therefore appear to represent an alteration in the speed and extent of visual-purple regeneration rather than a local effect upon the nervous mechanism. The decrease in the serum vitamin-A level accompanying the improvement in dark adaptation suggests that the thyroid extract and a-dinitrophenol facilitated the utilization of vitamin A by the eye.

Edna M. Reynolds.

Sheftel, A. G. **Dark adaptation and vitamin-A deficiency.** Amer. Jour. Clin. Path., 1940, v. 10, Feb., p. 168.

The author describes a new technique for determination of vitamin-A deficiency.

Tikhomirov, A. A. **Vitreous changes in tuberculous choroiditis.** Viestnik Opht., 1940, v. 17, pt. 4, p. 352.

A review of the literature and a report of four cases. The author believes that the opacities in the vitreous are analogous to precipitates on the posterior corneal surface, and that their appearance indicates the extension of the tuberculous process into the vitreous.

Ray K. Daily.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Kurlat, Pedro. **Another case of neuritis papulosa of Fuchs.** Arch. de Oft. de Buenos Aires, 1939, v. 14, Sept., p. 859.

A case is reported in which the condition was bilateral, with connective-tissue strands extending from the disc to neighboring areas of chorioretinitis. The patient, a woman of 39 years, had had the ocular disease when she was 14 years old and had come under observation in the cicatricial stage. Vision was considerably reduced, the blood Kahn was intensely positive, and the fundus condition was similar to the classical picture described by Fuchs. The differential diagnosis is discussed.

Plinio Montalván.

NEWS ITEMS

Edited by Dr. Ralph H. Miller, 803 Carew Tower, Cincinnati

News items should reach the editor by the twelfth of the month

Deaths

Dr. Paul Dee Berrisford, Saint Paul, Minnesota, died April 17, 1941, aged 55 years.

Dr. Edgar Francis Smith, Storm Lake, Iowa, died March 8, 1941, aged 67 years.

Dr. Herbert Livingston Scales, Hutchinson, Kansas, died March 28, 1941, aged 71 years.

Dr. William E. Caterson, Noblesville, Indiana, died April 6, 1941, aged 78 years.

Dr. George Johnson Tompkins, Lynchburg, Virginia, died April 2, 1941, aged 82 years.

Dr. Ralph C. Matheny, Galesburg, Illinois, died April 18, 1941, aged 82 years.

Dr. William Fritchey Roth, Wilkes-Barre, Pennsylvania, died April 1, 1941, aged 69 years.

Dr. DeForrest Elmer Tiffany, San Jose, California, died March 31, 1941, aged 69 years.

Dr. Robert Merriam Rogers, Brooklyn, New York, died May 13, 1941, aged 57 years.

Dr. Dikran M. Yazujian, Trenton, New Jersey, died April 25, 1941, aged 61 years.

Dr. Manford Repp Waltz, Seattle, Washington, died April 20, 1941, aged 50 years.

Dr. Harold L. Warwick, Fort Worth, Texas, died April 28, 1941, aged 63 years.

Dr. Eugene T. Stephenson, Washington, D.C., died April 12, 1941, aged 68 years.

Dr. Harold Kalling, Black River Falls, Wisconsin, died March 9, 1941, aged 71 years.

Dr. J. Frederick Hill, Waterville, Maine, died May 1, 1941, aged 86 years.

Dr. Lee E. Parr, Beeville, Texas, died April 22, 1941, aged 83 years.

Societies

The New York Society for Clinical Ophthalmology announces the following officers for the year 1941-1942: Dr. James W. Smith, president; Dr. Isadore Givner, vice-president; Dr. Sidney A. Fox, recording secretary; Dr. Benjamin Esterman, corresponding secretary; and Dr. Sigmund A. Agatston, treasurer.

Personals

The Journal is pleased to note that Dr. William Thornwall Davis of Washington, D.C., was one of the recipients of the Alumni Achievement Award presented by the graduates of George Washington University in recognition of his outstanding work in establishing a post-graduate course in ophthalmology and aviation medicine in ophthalmology. The latter was the first course of its kind given and attracted world-wide notice.

Dr. Arthur J. Bedell, emeritus professor of ophthalmology at Albany Medical College, Albany, New York, received the honorary degree of Doctor of Science from Hobart College, Geneva, New York, at their commencement on May 26th. He was also awarded the honorary degree of Doctor of Science from the University of Colorado, Boulder, Colorado, at their commencement on June 9th.

Dr. Arno Town, examining ophthalmologist of the New York City Draft Board, addressed the National Society for the Prevention of Blindness at its meeting in Atlantic City on June 5th on matters pertaining to visual defects in the draftees.

Dr. Ralph P. Sproule, Milwaukee, presented a paper on "Eye injuries" before the Upper Peninsula Medical Association in Ironwood, Michigan, on July 18th.

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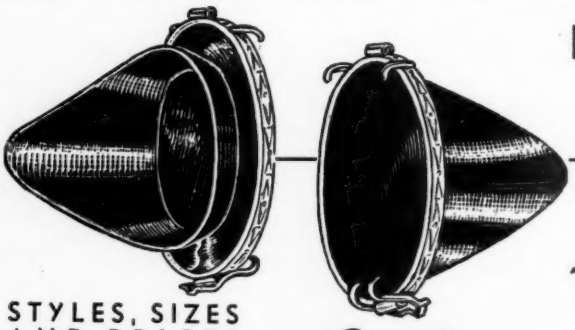

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